Perceptions of food naturalness and the influence of ingredient statements, colors, and flavors

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Abstract

Food selection and consumer behavior are popular topics of study due to the benefits to both academics and food producers. A less studied area, however, is consumer perceptions of naturalness. Neither the U.S. Food and Drug Administration nor the U.S. Department of Agriculture have an official definition for what constitutes as a natural food, although both organizations have general guidelines. This, combined with a lack of consumer understanding of the term, make natural food a complex and important topic to study. Work has been done to study the consumer definition of natural and perceptions of natural food, but no work has studied how food ingredient statements affect consumer perceptions of product naturalness. The objectives of this study were (1) to understand how food ingredient statements influence perceptions of naturalness, (2) to understand how ingredient statement length impacts perceptions of naturalness, (3) to understand how artificial and natural colors and flavors influence perceptions of naturalness, and (4) to understand how product identity and ingredient statements affect naturalness perceptions of whole, non-processed foods. An online survey was launched in the United States, United Kingdom, and Australia, recruiting 1000 consumers in each country. The results of the survey found that consumers use several cues to determine the naturalness of a food product. Product identity has a large impact, but naturalness perceptions can be influenced by the presence of an ingredient statement. Both artificial colors and artificial flavors are perceived as less natural by consumers, but other ingredients also have an effect. Products with ingredient statements that contain a high volume of ingredients with unfamiliar, chemical sounding names lower perceptions of naturalness. Additionally, products with longer ingredient statements are perceived to be less natural than products with short ingredient statements. The location of certain ingredients within the statement also influence naturalness
perceptions. When the colorant was located at the end of the ingredient statement, the product was perceived as less natural than when the colorant was located in the middle. Products that come from plants and products that are physically processed are seen as more natural than products with unhealthy ingredients and products that are highly processed. In general, males, Millennials, and consumers with more education and higher income perceived the presented food products as more natural than others in their respective demographic groups. There were also no large differences in perception between US, UK, and Australian respondents. The results from this research project help to form a more complete picture of consumers’ perceptions of natural food and help to understand the importance of ingredient statements in forming these perceptions.
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Chapter 1 - Literature Review

Ambiguous Definition of “Natural”

“Natural” is a claim that can be seen on many food items in all sections of the grocery store. This claim, however, is controversial because there is no established definition informing consumers what “Natural” really means. In the United States, three government organizations are responsible for various aspects of the “Natural” label claim: the FDA, the USDA, and the FTC (Parasidis, 2015). The FDA and USDA are responsible for “Natural” label claims on foods and beverages with the USDA in charge of meat, poultry, and egg products and the FDA responsible for all other foods and beverages. The FTC is responsible for advertising of foods and beverages (Parasidis, 2015). In 1993, the FDA ruled not to define the term “Natural”, but stated that they would not restrict its use with the exception of products containing “added color, synthetic substances, and flavors” (Department of Health and Human Services, 2015). As of 2015, the USDA guidelines state that “Natural” products cannot contain artificial ingredients or added colors and must be minimally processed, meaning that the food cannot be fundamentally altered. Additionally, in order to make the “Natural” claim, the USDA requires that manufactures reveal why the food is considered “Natural” (for example, a callout stating “no artificial ingredients; minimally processed”) (FSIS, 2015). Though the USDA has guidelines regarding “Natural” label claims, no current definition exists to help consumers when making food selections. In fact, many American consumers do not know the difference between natural foods and Organic foods. Authors K.M. Abrams and C.A. Meyers presented their findings from focus group studies conducted to gather consumer thoughts and opinions about natural foods. They found that some consumers do not know the difference between organic foods and natural foods. They also discovered that some consumers are suspicious of the “Natural” claim and believe that it is just a
marketing tactic to increase sales (Abrams, 2010). Canadian consumers are more comfortable with organic products because of the clear definitions in place (Mintel, 2018). The lack of a formal definition does not help consumers who are unsure what “Natural” means and if it is even a real claim. According to proprietary research conducted by FONA in 2017 and published in 2018, 40% of respondents to their consumer survey do not trust the “Natural” claim. They also found that 45% of respondents reported that they read ingredient statements to determine if the products are in line with their personal definitions of “Natural” (FONA, 2018).

Even without an official definition, however, natural foods are sought after by consumers. Nielsen found that between 2012 and 2014, sale of natural products has increased by 24% (Nielsen, 2015). According to their 2016 Global Ingredient and Out-Of-Home Dining Trends Report, Nielsen found that sales of salty snacks with a “Natural” claim grew by 5.7% between 2015 and 2016, compared to just 2.6% growth for the salty snack category as a whole (Nielsen, 2016). Market research company Mintel reports that “Natural” claims have decreased by 62% in Canada in the past 10 years. Canadian food and beverage companies have started to replace “All Natural” claims with less vague claims like “GMO-Free” and “Preservative-Free” (Mintel, 2018). Regardless of the number of claims, including “Natural” or “All-Natural” on food and beverage labels appears to increase sales. According to Consumer Report’s Natural Food Labels Survey from 2015, 62% of U.S. consumers purchase food labeled “Natural” and 87% are willing to pay more for food labeled “Natural” (Consumer Reports, 2015). Mintel also found that though the number of “Natural” claims is falling, 29% of Canadian consumers report buying more natural foods and beverages in 2018 than in they did in 2017 (Mintel, 2018). Nielsen reports that 58% of global respondents want more all-natural products in the market (Nielsen, 2016). When making purchases, 43% of global respondents, 29% of North American
respondents, 42% of European respondents, and 64% of Latin American respondents reported that “All-Natural” was an important feature of foods and beverages (Nielsen, 2015).

Additionally, among those that believe “All-Natural” foods are at least slightly important to them, 39% of global consumers and 24% of North American consumers are willing to pay more for foods with this label claim (Nielsen, 2015). S.R. Dominick found that 48-57% of respondents were likely to purchase various food products with “All-Natural” label claims (Dominick, 2018).

On a global level, it is clear that consumers are interested in about “All-Natural” foods and beverages. In 2016, the FDA, in response to increasing interest and questions from consumers, asked the public for information and comments regarding the “Natural” label claim. Though the comment period has ended, they still state that they have not “engaged in rulemaking to establish a formal definition for the term ‘natural’”, though they do provide their “longstanding policy” on the subject (Center for Food Safety and Applied Nutrition, 2018).

A large part of the FDA’s policy on the “Natural” label claim centers around the word “no”, as in nothing artificial/synthetic (Center for Food Safety and Applied Nutrition, 2018).

Many authors have gathered data on how consumers define the term “Natural” and reached similar conclusions that the definition revolves around the word “no”. In their focus groups, K. M. Abrams and C. A. Meyers found that the consumer definition of “Natural” includes no additives, no preservatives, no hormones, and no chemicals (Abrams, 2010). In a review of 72 articles about the importance of naturalness to consumers, Author Sergio Román found that consumers think “Natural” foods should have no artificial colors, no additives, no human intervention, etc. (Román, 2017). More specifically, Paul Rozin found that the absence of human intervention was important to consumers and their definition of “Natural” includes no processing, no alterations, no contact with humans, and no industrial intervention (Rozin, 2012).
So, what is a “Natural” Food?

In addition to all the “no’s”, consumers also consider some positive aspects associated with the “Natural” label. These positive features include minimally processed, organically grown, increased animal handling and welfare, improved nutritional value, improved food safety, improved taste, etc. (Abrams, 2010; Román, 2017; Dominick, 2018). In an online survey, author S. R. Dominick found that 63% of respondents believe foods labeled as “Natural” are more nutritious and safer, 60% believe natural foods are better for animal well-being, and 56% believe natural foods taste better than their conventional counterparts (Dominick, 2018).

Paul Rozin found that consumers believe that physical changes (like freezing and thawing) are more natural processes than chemical changes (like fat reduction) (Rozin, 2005). This conclusion was supported by findings from a questionnaire-based study by Evans et al conducted in Australia (Evans, 2010). Rozin also concluded that “process is more important than content” when respondents reported that genetic engineering is less natural than domestication even though genetic engineering (specifically, the insertion of a single gene) involves less human intervention than domestication, which can take generations (Rozin, 2005). He supported the process over content results with follow-up study that found that a food product that was “doubly-transformed” (tomato paste with sucrose removed, then added back in) was less natural that a once transformed product even if the twice transformed product was chemically identical to the original product (Rozin, 2006). Evans et al. found contrary results in their questionnaire-based study. Respondents rated products made with vegetable powder to be significantly less natural than products made with fruit powder and products made with fruit powder were rated significantly less natural than products made with fruit pulp. He concludes that both process and content impact the perception of naturalness, but ultimately, content is more important (Evans,
This study by Evans et al. explored additional food qualities than impact the consumer perception of naturalness. As more additives are added to a product, the less natural a food is considered. Only a small amount of additives added to a food product (as little as 2%) can decrease naturalness ratings, but beyond a certain threshold (between 4 and 6%), the score does not continue to decrease. This threshold, however, was not seen with processing. Evans states that a linear relationship exists in which the more processing a food product receives, the less natural it is perceived to be. He also found that products made with ‘like’ additives are considered by respondents to be more natural than products made with dissimilar additives. For example, a carrot soup made with black carrot concentrate was considered more natural than a tomato sauce made with black carrot concentrate. Food products that were made with fruit powder and black carrot were rated as more natural than the same products made with starch and gums even though the former two ingredients are likely to be more novel to consumers (Evans, 2010). Though fruit powder and black carrot may be novel to consumer, it is likely the name of the ingredient that affects perceptions of naturalness. Evans et al. found that the presence of an E-number on an ingredient label was perceived as less natural than the same label with a chemical name or common name instead. The presentation of ingredient names on food labels has been found by other authors to impact consumers’ perceptions of naturalness. Michael Siegrist and Bernadette Sütterlin found that including the E-number on a label instead of a chemical or common name significantly decreased the perception of naturalness (Siegrist, 2017). Chambers V et al. found that inclusion of an ingredient’s chemical name also influences perceived naturalness, as Sodium Bicarbonate was rated as less natural than baking soda. They note this as a good example of familiarity bias where consumers perceive foods or ingredients they are more aware of as more natural than novel foods or ingredients. Additionally, wheat flour
was perceived as more natural than sorghum flour, though both are flours made from cereal grains. Along with familiarity, Chambers V found that insect powder was perceived as natural only by a small percentage of respondents, suggesting that neophilia may also play a role in naturalness perceptions. In the same online survey, the team found that none of the ingredients were considered natural by 100% of the respondents and corn was considered natural by the largest percentage of consumers, still only at 69%. They note that two of the ingredients considered to be natural by the most respondents, corn and soybeans, are some of the most commonly genetically modified foods in the market. Both of these ingredients, however, are considered healthy by many consumers, which may have affected perceptions of naturalness (Chambers, 2018). Rozin et al. found that respondents to their questionnaire believe that natural foods are considered healthier than their conventional counterparts (Rozin, 2004).

Besides food or ingredient cues, packaging cues also influence perceptions of naturalness. Anne-Sophie Binninger found that the perceived naturalness of product packaging could give an indication of the naturalness the product inside. The more natural the packaging is perceived to be, the more credible and attractive the product is to consumers. Consumers also believe that “Natural” packaging is associated with higher quality products and increases their intent to purchase (Binninger, 2017).

Many studies have noted that consumers perceive positive qualities and characteristics with natural food products (Rozin, 2004; Rozin, 2012; Dominick, 2018). Thus, Apaolaza et al. studied this possible halo effect associated with the “Natural” claim. When exposed to the claim “Perfumes made of 100% natural ingredients” participants’ overall acceptance scores and intention to purchase increased. Additionally, ratings of the perfume’s naturalness as well as ratings of affective terms, like pleasantness and joy, increased compared to a control group not
exposed to the claim. They conclude that there is strong evidence of a halo effect with the term “Natural” and this could be influencing liking and purchase intent with these products (Apaolaza, 2014).

More about “Natural” Consumers

In addition to assumptions about natural foods, consumers form assumptions about natural food consumers. The team of Taylor and Stevenson hypothesized that people think more highly of consumers of natural foods. Through both online and in-person studies, they found that natural food consumers are considered more virtuous and healthier than “unnatural” food consumers are (Taylor, 2018). They state some possible explanations for these associations. Someone who consumes natural foods must possess those positive characteristics associated with natural foods. If consumers may associate natural foods with moral attributes like healthiness, then someone who consumes natural foods must also be healthy. If “unnatural” foods are associated with being less eco-friendly and worse for animal welfare, than consumers of natural foods must not support these ideals and, therefore, have higher moral character (Taylor, 2018). Along with these morality characteristics, Taylor and Stevenson found that people associate natural food consumers with being more feminine, more educated, wealthier, and older (Taylor, 2018). In their review of related studies, Román et al. found that gender and age were the most studied demographics in studies focusing on naturalness. They also determined that female and older consumers are more receptive to natural foods in those two demographics (Román, 2017). Bäckstrom et al. and Dominick et al. support the finding that female consumers are more receptive to natural foods than male consumers (Bäckstrom, 2004; Dominick, 2018). Bäckstrom et al. also found that naturalness is more important to consumers living in rural areas than those
living in urban areas (Bäckstrom, 2004). In a study of U.S. consumers, market research companies IRI and SPINS found two segments that comprise just under half of all natural and organic food sales. The first, called “True Believers”, consists of consumers with a medium income of $65,000, an average age of 40, attended college, and are interested in trying new things and staying healthy. These consumers also believe that natural and organic products have benefits for the consumer. The second segment, called “Enlightened Environmentalists”, average at 63 years old, attended graduate school, have a medium income of $57,000, and are passionate about the environment. This group is also likely to shop at stores that specifically carry natural and organic food products (Business Wire, 2013). Though gender and age are the most studied demographics, interest in the traits and attitudes of natural consumers is valuable to food manufacturers who wish to tailor their marketing strategies to increase sales of their natural products. Based on these studies, consumers with the most interest in natural foods tend to be female and older. They are also likely to have a college degree, value a healthy lifestyle, and be more trustworthy, though these results were found in fewer studies.

Natural and Artificial Colors and Flavors

Much work has been done on natural foods in general. Fewer studies have looked specifically at two groups of ingredients that play a big role in the natural food movement: colors and flavors. For years, artificial colors and flavors have been used to attract consumers, to make up for processing losses, and to create exciting and unique sensory profiles in foods and beverages. The main benefit of artificial over natural is cost. Artificial colors and flavors are cheaper than their natural counterparts are because they have been synthesized in a lab as opposed to being extracted from natural sources (Gebhardt, 2015). Along with cost, natural
colors and flavors need to be used in larger amounts in food formulations to get the same effect as artificial. Sources of natural color, for example, may contain 2% or less of the desired pigment whereas artificial colors are 90% pigment (Gebhardt, 2015). Natural colors are derived from minerals, plants, animals and microorganisms (Sigurdson, 2017). Natural flavors are more commonly derived from plants. Spices and essential oils from various plant sources are commonly used to increase the flavor and aromatic profiles of foods and beverages (Attokaran, 2017). In their review on food additives, Carocho states that the use of colors and flavor additives differ by country with European countries tending to have stricter allowances of additives in food and beverage products. One of the main reasons for the shift from artificial to natural additives involves concerns about the influence of artificial additives and unwanted health problems (Carocho, 2014; Carocho, 2015; Martins, 2016). Bearth found that respondents to a mail survey perceived risk with the consumption of artificial colors, specifically (Bearth, 2014). Though natural colors and flavors are thought to be safer, some drawbacks include instability from pH and temperature, oxidation losses, higher usage rates, and higher manufacturing costs (Carocho, 2014; Martins, 2016).

In general, natural food additives are significantly more acceptable to consumers than artificial additives (Siegrist, 2017). There was no difference to consumers whether an additive was synthetic or nature-identical (synthetic additives that imitate natural ones); additives made by humans have greater perceived risk than natural additives (Siegrist, 2017; Carocho, 2014).

Globally, Nielsen found that artificial flavors and artificial colors are the first and second most avoided ingredients by consumers (62% and 61%, respectively). Both are in the top five most avoided ingredients in Asia-Pacific, Europe, Africa/Middle East, and Latin America, but not in the top five in North America (Nielsen, 2016). Among those (globally) who avoid certain
ingredients in foods, 84% state that they avoid artificial colors and flavors because they believe these ingredients are harmful to their health (Nielsen, 2016). 75% of global respondents indicated that they are worried that artificial ingredients may have long-term impacts on their health and 69% of global respondents reported that foods without artificial ingredients are better for health. Additionally, 45% and 43% of global respondents want more products in the market with no artificial colors and no artificial flavors, respectively (Nielsen, 2016). 42%, 41%, and 36% of global respondents consider no artificial colors, no artificial flavors, and presence of natural flavors (respectively) to be very important when making purchase decisions (Nielsen, 2015).

Research Objectives

The source of colors and flavors is important to consumers all around the globe. It is evident that the presence of artificial colors and flavors on food labels influences perceptions of naturalness, but it is not as clear if differences in perceptions exist between various demographic groups. Few studies have made comparisons cross cultures and not much work has been done to determine reasons beyond health-related ones that consumers avoid artificial colors and flavors. Based on the review literature, it is hypothesized that the presence of artificial colors or flavors on an ingredient statement will reduce consumers’ willingness to purchase as well as their ratings of product naturalness. Additionally, it is not clear how much consumers know about the sources of natural colors and flavors and if all sources of natural colors and flavors considered equally natural. Carmine is a color pigment derived from the Dactylopius coccus insect species and the carotenoid astaxanthin is derived from the bacterium Paracoccus carotinifaciens (Sigurdson, 2017). If neophobia impacts perceptions of naturalness, it is hypothesized that these sources of color will be perceived as less natural than other color sources. More research is needed to
understand the effect that colors and flavors, specifically, have on consumer perceptions of
naturalness. The objectives of this study are: (1) to determine the affect natural and artificial
colors and flavors have on perceptions of naturalness and willingness to pay, (2) to understand
how consumer demographics influence perceptions of naturalness, (3) to determine if the length
of an ingredient statement impacts perceptions of naturalness and willingness to pay, and (4) to
determine how the ingredient statement impact the perceptions of naturalness of whole food
items like bananas.

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Chapter 2 - Impact of Statement Length and Ingredient Location on Perceptions and Behaviors

Abstract

Research has shown that food labeling can influence perceptions of food and beverage products, yet little work has been done on the ingredient statement, specifically. The objectives of this research were to understand how ingredient statement length and the presence of artificial or natural colorants impact purchase behavior and perceptions of naturalness. An online survey was launched in the United States, United Kingdom, and Australia, targeting 1000 consumers in each region. Results showed that the length of the statement and the location of ingredients within the statement impact likelihood of purchase and perceptions of naturalness. Short statements with the colorant listed in the middle were the most likely to be purchased and considered the most natural whereas the long statements were considered the least natural and thought to have unhealthy ingredients. The location of the colorant in a statement is believed to draw attention to color additives, affecting consumer perceptions. A long ingredient statement with natural colors, though perceived to be more natural, is less likely to be purchased due to the high volume of ingredients with chemical sounding names. Males and younger participants were generally more willing to purchase and gave higher naturalness scores. Long ingredient statements are also associated with being more unhealthy than shorter ingredient statements.

Introduction

The ingredient statement is one of the components found on almost every processed food and beverage sold in many countries around the globe. In the United States (US), two agencies
For the US, USDA is responsible for ingredient statements on meat, poultry, and egg products and FDA is responsible for ingredient statements on all other foods and beverages (FSIS, 2007; Center for Food Safety and Applied Nutrition, 2013). Both agencies require that all ingredients be listed on the statement in descending order based on the weight of the ingredients in the formulation (FSIS, 2007; 21CFR101, 2018). Ingredients that make up the smallest proportion in the formula follow a statement that declares “Contains __ percent or less of” or “Less than __percent of”. This threshold is commonly 2%, but can also be 1.5, 1.0, or 0.5%, depending on the formulation (FSIS, 2007; 21CFR101, 2018). Sub-ingredients, or ingredients that are part of an ingredient used in the formulation, are listed in parenthesis following the name of the main ingredient (Center for Food Safety and Applied Nutrition, 2013). The common name of ingredients are listed on the statement (Sugar or Baking Soda, for example), but different rules apply for colors and flavors. Certified colors are listed by their specific names (FD&C Yellow No. 5 or Yellow 5) and non-certified colors are listed by their common name (Caramel Coloring, Vegetable Juice for Color) or as “artificial color” and/or “natural color”. Flavors are declared as “artificial flavor” and/or “natural flavor” (Center for Food Safety and Applied Nutrition, 2013).

Previous work has been done to study various aspects of food labeling and the effects they have on consumers from various countries. Research has been done on label use (generally and with specific demographics), nutrition label use, consumer beliefs about nutrition labels, understanding of nutrition labels, and areas of nutrition labels most used by consumers (Campos, 2011). Additionally, research has been conducted to study the impact of product name and
descriptions on perception, impact of nutrition labeling on consumer expectations and sensory perceptions, impact of label and ingredient claims on expectations of liking and actual liking, impact of pictures and photographs on expectations and sensory perceptions, and the impact of organic certification logos on willingness to pay and preference (Piqueras-Fiszman, 2015; Schouteten, 2015; Janssen, 2012).

Not much work has been done to study the effect of ingredient statement length on consumer perceptions. However, Nielsen reports that 52% of respondents from Asia-Pacific, 50% from Europe, 53% from Africa/Middle East, 46% from Latin America, and 61% of North American respondents strongly or somewhat agree that shorter ingredient statements correlate with healthier food and beverage products (Nielsen, 2016). In addition, not much research has been conducted to study the association between the ingredient statement and perceptions of naturalness.

The term “Natural” has not been officially defined by the FDA in the United States (Department of Health and Human Services, 2015). The FDA and USDA, however, do have “guidelines” for what foods constitute as “Natural” (Department of Health and Human Services, 2015; FSIS, 2015). Both organizations state that “Natural” foods must not contain artificial/synthetic ingredients and the USDA specifies that “Natural” foods must be minimally processed (not fundamentally altered) (Center for Food Safety and Applied Nutrition, 2018; FSIS, 2015). To make up for the lack of an official definition, research has been conducted to understand what “Natural” means to consumers. Similar to the government organizations, consumers believe the definition of “Natural” includes no additives, no preservatives, no hormones, no processing, no alterations, and no human intervention (Abrams, 2010; Román, 2017; Rozin, 2012). No artificial colors in the formulation was explicitly mentioned by
Consumers (Román, 2017). Consumers also believe “Natural” foods should be organically grown, better for animal welfare, better nutritionally, safer to consumers, and better tasting (Abrams, 2010; Román, 2017; Dominick, 2018).

Chambers et al. studied consumer perceptions of naturalness for various food ingredients. Of the selected ingredients, none were found to be natural by 100% of the 630 American consumers. They reported that Corn, Wheat Flour, and Black Beans were perceived as the most natural and Maltodextrins, Butylated Hydroxyanisole (BHA), and Sodium Acid Pyrophosphate (SAPP) were perceived as the least natural (Chambers, 2018). Novel ingredients, such as Insect Powder and Pea Flour, were perceived as natural by a relatively small percentage of respondents, indicating that neophobia may affect perceptions of naturalness. Additionally, respondents were more likely to report familiar ingredients, like wheat flour, as natural compared to less familiar ingredients, like sorghum flour, though both are flours derived from cereal grains. Finally, they found that the ingredient name impacts naturalness, as Baking Soda was reported as natural by more participants than Sodium Bicarbonate, the same product identified by its chemical name (Chambers, 2018).

Although the relation between specific ingredients and perceptions of naturalness has been studied, no work has been done to understand the relationship between ingredient statement length and consumer perceptions of naturalness. This study was conducted to fill this gap in knowledge. The objectives of this study were (1) to understand the differences in perceptions of naturalness of long, intermediate, and short ingredient statements, (2) to understand how ingredient statement length impacts likelihood of purchase, (3) to understand how the presence of artificial and natural colors impacts perceptions of naturalness in ingredient statements of
varying lengths, and (4) to understand consumer knowledge about the sources of color in ingredient statements.

**Materials & Methods**

A survey using a standardized questionnaire was used by consumers in three countries: United States of America (USA), the United Kingdom (UK), and Australia (AUS) to gather data for this research.

**Questionnaire**

Participants were shown eight ingredient statements followed by four questions (questionnaire available in the Appendix). Of the eight statements, two were long (more than 15 ingredients), two were intermediate (between 6 and 15 ingredients), and four were short (no more than 5 ingredients). One of the long and intermediate ingredient statements and two of the short ingredient statements contained artificial colors and the remaining statements contained natural colors. The locations of the colorants were varied in the short ingredient statements. One of the short statements with natural/artificial colors had the color additive at the end of the statement and the other had the additive in the middle of the statement. Ingredient statements of varying lengths were chosen to understand the affect that statement length has on perceptions of naturalness and purchase intent.

The ingredient statements were selected from existing products in the US and then modified as needed for the research. They were presented blind, without product names, as they appeared on the product label in most cases. Any potential biasing information was removed from the ingredients statement to obscure the product identity from the respondents. For
example, “Flamin’ Hot Seasoning” was removed from the ingredient statement and replaced with a nondescript statement so that participants would not associate the label with Flamin’ Hot Cheetos®. Ingredient statements used in the survey can be found in the appendix.

Following each ingredient statement, participants were asked to rate their likelihood to purchase (9-point fully labeled scale from ‘Extremely unlikely’ to ‘Extremely likely’) and their perceptions of naturalness (9-point scale labeled at the ends with ‘Not At All Natural – 1’ to ‘Extremely Natural – 9’). Next, participants were shown a Check All That Apply (CATA) question and asked to select which items from the list of statements they believe apply to the ingredient label. Finally, the participants were shown a CATA list of all the ingredients present in the statement and were asked to select all the items they believed were sources of color in that food. Compound ingredients were kept together as a single item. For example, a leavening system was shown as “Leavening (Baking Soda, Sodium Acid Pyrophosphate)”.

Along with ingredient statement questions, participants were asked various demographic questions including gender, age, race/ethnicity (using race demographics commonly used in each country/region), education level, income (using income brackets commonly used in each country/region), and number of children. Additionally, participants were asked how often they read ingredient statements, how often they pay attention to the source of coloring/flavors on labels, importance of color/flavor on the label, and likelihood to purchase based on the presence of artificial colors/artificial flavors. Participants were also asked how often they consume various foods from a list of foods that contain color additives, in CATA format. Items from the Health and Taste Attitudes Scale were included to further segment participants.
The online survey was launched in the United States, the United Kingdom, and Australia using Qualtrics Survey Software (Provo, UT, USA), recruiting 1,000 participants from each country/region. These countries/regions were chosen because English was spoken as the native language and so comparisons could be made across cultures within a common language, with slight variation in spelling and wording. Three quotas were employed to recruit potential participants: gender (50% males, 50% females), age (20-25% for 18-23, 24-41, 42-52, and 53-73; 10% or less for 74 years or older), and estimate of household grocery shopping. Participants were not included if they were under 18 years of age or if they did less than 40% of the grocery shopping for their household. Rather than using traditional age demographic brackets, generational groups were used. In order of appearance, from youngest to oldest, these generation groupings were Centennials/Gen Z, Millennials/Gen Y, Gen X, Baby Boomers, and Silent Generation. Rather than financial compensation, Qualtrics uses a reward system to compensate respondents for their participation.
Table 2-1. Demographic percentages*

<table>
<thead>
<tr>
<th>Demographic Characteristics</th>
<th>Categories</th>
<th>US</th>
<th>UK</th>
<th>AUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Male</td>
<td>48%</td>
<td>50%</td>
<td>48%</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>52%</td>
<td>50%</td>
<td>52%</td>
</tr>
<tr>
<td>Age</td>
<td>Centennials/Gen Z</td>
<td>25%</td>
<td>15%</td>
<td>14%</td>
</tr>
<tr>
<td></td>
<td>Millennials/Gen Y</td>
<td>18%</td>
<td>23%</td>
<td>24%</td>
</tr>
<tr>
<td></td>
<td>Gen X</td>
<td>26%</td>
<td>26%</td>
<td>26%</td>
</tr>
<tr>
<td></td>
<td>Baby Boomers</td>
<td>20%</td>
<td>26%</td>
<td>26%</td>
</tr>
<tr>
<td></td>
<td>Silent Generation</td>
<td>11%</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>Race/Ethnicity</td>
<td>American Indian/Alaska Native</td>
<td>1%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Asian</td>
<td>4%</td>
<td>5%</td>
<td>12%</td>
</tr>
<tr>
<td></td>
<td>Black/African/Caribbean</td>
<td>10%</td>
<td>3%</td>
<td>1%</td>
</tr>
<tr>
<td></td>
<td>Hispanic/Latino</td>
<td>6%</td>
<td>0%</td>
<td>1%</td>
</tr>
<tr>
<td></td>
<td>Caucasian/White</td>
<td>77%</td>
<td>90%</td>
<td>82%</td>
</tr>
<tr>
<td></td>
<td>Aboriginal/Torres Strait</td>
<td></td>
<td></td>
<td>1%</td>
</tr>
<tr>
<td></td>
<td>Pacific Islander</td>
<td>0%</td>
<td></td>
<td>1%</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>1%</td>
<td>&lt;1%</td>
<td>1%</td>
</tr>
<tr>
<td></td>
<td>Prefer Not to Answer</td>
<td>1%</td>
<td>2%</td>
<td>1%</td>
</tr>
<tr>
<td>Education</td>
<td>High School or Less</td>
<td>25%</td>
<td>34%</td>
<td>33%</td>
</tr>
<tr>
<td></td>
<td>Associate Degree/Some College</td>
<td>32%</td>
<td>18%</td>
<td>25%</td>
</tr>
<tr>
<td></td>
<td>College Degree</td>
<td>27%</td>
<td>33%</td>
<td>27%</td>
</tr>
<tr>
<td></td>
<td>Post Graduate</td>
<td>16%</td>
<td>13%</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td>Prefer Not to Answer</td>
<td>1%</td>
<td>2%</td>
<td>1%</td>
</tr>
<tr>
<td>Number of Children</td>
<td>No Children</td>
<td>66%</td>
<td>64%</td>
<td>63%</td>
</tr>
<tr>
<td></td>
<td>One Child</td>
<td>14%</td>
<td>16%</td>
<td>16%</td>
</tr>
<tr>
<td></td>
<td>Two Children</td>
<td>16%</td>
<td>14%</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td>Three Children</td>
<td>3%</td>
<td>5%</td>
<td>4%</td>
</tr>
<tr>
<td></td>
<td>Four or More Children</td>
<td>2%</td>
<td>1%</td>
<td>2%</td>
</tr>
</tbody>
</table>

* Percentages were based on 932, 959, and 969 respondents from the US, UK, and AUS, respectively.
Excel (Microsoft Office Pro ver. 2013) was used to calculate means and percentages, for descriptive statistics, and for chi-square tests for significance (p-values less than 5% were considered significant). For the analysis, the 9-point point scales were converted into 3-point scales (Unlikely or Unnatural, Neither nor, Likely or Natural) to more easily report any existing trends in behavior/perception. XLSTAT (Addinsoft, New York, NY, USA) was used for Analysis of Variance and Correspondence Analysis for CATA data. Participants with incomplete

### Table 2-2. Income demographic percentages*

<table>
<thead>
<tr>
<th>Demographic Characteristics</th>
<th>Categories</th>
<th>US</th>
<th>UK</th>
<th>AUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>27%</td>
<td>25%</td>
<td>17%</td>
<td>12%</td>
<td>10%</td>
</tr>
</tbody>
</table>
* Percentages were based on 932, 959, and 969 respondents from the US, UK, and AUS, respectively.
responses were excluded from the analysis. Because some respondents are inattentive and may
answer questions without really thinking or simply checking boxes without reading the question
(Baker and Le Guin, 2007; Allen, 1966) a fake or “cheater” question (e.g. Yang et al., 2015) was
included in the survey. Participants were excluded from the analysis if they reported consuming
‘Live worms’ or ‘Pickled chicken’ in the past week. After exclusion, 969 respondents from
Australia, 959 respondents from the UK, and 932 respondents from the US were included in the
analysis.

Results and Discussion

United States

The length of the ingredient statement had a great effect on purchase behavior and
naturalness perceptions. The products represented by the short statements were the most likely to
be purchased and were perceived as the most natural (Figures 2-1 and 2-2). American
respondents were slightly less likely to purchase these products than they were to report them as
natural. The products with long statements were the least likely to be purchased and were
perceived as the least natural. Respondents were slightly more likely to purchase the products
with the long statements than they were to report them as natural. There was a significant
difference in both likelihood to purchase and perceived naturalness between both of the products
with long statements and all of the products with short statements. The products with
intermediate statements were split, however, and were not significantly different from either the
products with long statements or the products with short statements.

The presence of artificial or natural colors also had an effect on purchase behavior and
naturalness perceptions (Figures 2-1 and 2-2). The naturally colored products with short and
intermediate statements were more likely to be purchased and perceived as more natural than their artificially colored counterparts. The products with short statements were more likely to be purchased and perceived as more natural than the products with intermediate statements. The products with short statements and the colorant listed in the middle of the statement were more likely to be purchased and perceived as more natural than when the colorant was listed at the end, although this difference was not significant. American respondents perceived the naturally colored product with an intermediate statement to be significantly more similar to the products with short statements than to those with long statements. This same trend is present with likelihood to purchase, though it was not significant. The naturally colored product with the long statement was the least likely to be purchased. It was also perceived as significantly less natural than all of the other products.

For every statement, regardless of statement length or colorant, males were more likely to purchase and females were less likely to purchase. All of these differences were significant except for the naturally colored product with an intermediate statement and the product with a short statement and natural color listed in the middle. A similar trend can be seen with perceptions of naturalness. Males perceived all products, regardless of statement length or colorant, as more natural than females. There were no significant gender differences in natural perceptions for the naturally colored products with short statements. Younger generations were significantly more likely to purchase and older generations were significantly less likely to purchase the products with long and intermediate statements and the product with a short statement and artificial color in the middle. Millennials and Generation X were more likely to purchase the naturally colored products with short statements and the product with a short statement and artificial color at the end, although this difference was not significant for the
product with a short statement and natural color in the middle. Centennials and the Silent
Generation were less likely to purchase these products. Overall, the Millennials were the most
likely to purchase and the Silent Generation was the least likely. Millennials also perceived the
products as more natural. Younger generations gave higher naturalness scores to the products
with long and intermediate statements and older generations gave lower naturalness scores to
these products. Of the products represented by short statements, the product with artificial color
at the end was the only one with significant generational differences. Millennials and Gen X
perceived this product as more natural and Centennials and the Silent Generation perceived this
product as less natural. In general, respondents with higher levels of education and higher annual
income were more likely to purchase and had higher perceptions of naturalness. Parents were
more likely to purchase and perceived products as more natural. However, differences by
education level, income, and number of kids were not always significant. Respondents who
always read ingredient statements and who pay more attention to the source of color/flavor on
labels gave higher naturalness scores. There were significant differences for these demographics
for the products with long and intermediate statements, but not for the products with short
statements. Race/Ethnicity was not a good predictor of likelihood to purchase and perceptions of
naturalness.

American respondents who frequently consumed Toaster Pastries, Hard Candy, Cookies,
Ice Cream, Popsicles, Flavored Gelatin, Chewing Gum, Breath Mints, Breakfast Cereal,
Flavored Crackers, Fruit Yogurt, Fruit Juice, Soda, Energy Drinks, and Sports Drinks were more
likely to purchase. Many of these differences were significant, but there were very few
significant differences for the naturally colored products with short statements. This same trend
was present for perceptions of naturalness, except there were few significant differences for all
of the products with short statements. There were no significant differences for likelihood to purchase and perceptions of naturalness for frequent consumption of salad dressing.

Respondents who agree that artificially colored and flavored foods are not harmful for health are significantly more likely to purchase and have significantly higher perceptions of naturalness for all products. This difference was not significant, however, for the product with a short statement and natural colors in the middle. Respondents who disagree that artificially colored (48%) and flavored foods (48%) are not harmful for health are significantly less likely to purchase and have significantly lower perceptions of naturalness for all products. Respondents that agreed that they try to eat foods that do not contain additives and agreed that they would like to eat only organic vegetables were more likely to purchase the naturally colored products and perceived the long, intermediate, and naturally colored products with short statements as more natural. Respondents who agreed that they look for only non-GMO ingredients in the food they eat and always look for natural ingredients in the snack foods that they eat were generally more likely to purchase and perceived products as more natural.

The item “Has natural colors”, selected for the product with a short statement and natural colors at the end, was the only item chosen by over 50% of American respondents. The products with long statements were associated with “Too long”, “Has chemical names”, “Contains unnatural ingredients”, “Has unhealthy ingredients”, and “Don’t recognize ingredients”. The artificially colored product with a long statement was also associated with “Extra flavor added” and “Ingredients made in a lab”. All four artificially colored products were associated with “Has artificial colors” and “Extra color added”. The artificially colored products with long and intermediate statements were also associated with “Has unhealthy ingredients” and the intermediate statement product was associated with “Food sounds tasty”. The artificially colored
products with short statements were associated with “Has healthy ingredients”, but only the product with the colorant in the middle was associated with “Ingredients come from nature”.

There were no common associations for all of the naturally colored products. However, the products with intermediate and short statements were associated with “Has natural colors”, “Ingredients come from nature”, and “Has healthy ingredients”. No more than 18% of American respondents selected “Too short”, “Food sounds gross”, and “Not appropriate for kids”. No more than 9% chose “I believe I am sensitive to one or more of these ingredients”, “Ingredients cause cancer”, “Ingredients cause ADD/ADHD”, and “I have a diagnosed allergy to one or more of the ingredients”.

**United Kingdom**

The length of the ingredient statement had the greatest effect on UK respondents purchase behavior and perceptions of naturalness (Figures 2-1 and 2-2). The products represented by short ingredient statements were significantly more likely to be purchased and perceived as significantly more natural than the products with intermediate and long statements. UK respondents gave higher naturalness scores than likelihood to purchase scores to the products with short statements. The products represented by long ingredient statements were the least likely to be purchased and perceived as the least natural. These products received slightly higher scores for likelihood to purchase compared to ratings of naturalness. Purchase behavior and naturalness perceptions of the products with intermediate statements was more similar to the products with long statements than to the products with short statements.

The naturally colored products with short or intermediate statements were more likely to be purchased than their artificially colored counterparts were (Figures 2-1 and 2-2). These
products were also perceived as significantly more natural. Conversely, the product with a long statement and artificial colors was more likely to be purchased and perceived as significantly more natural than the naturally colored product. The location of the colorant in the statement affected purchase behavior and naturalness perceptions of the short statements. When the colorant was listed in the middle of the statement, the product received higher scores, although these differences were not significant. The naturally colored product with an intermediate length statement was perceived as significantly more natural than its artificially colored counterpart was. Similarly, the artificially colored product with a long statement was perceived as significantly more natural than its naturally colored counterpart was. There were, however, no significant difference in likelihood to purchase between the naturally and artificially colored products with intermediate and the naturally and artificially colored products with long statements.

Demographics were not great predictors of purchase intent or perceptions of naturalness for UK respondents. There were no significant gender differences for all products except for the naturally colored product with a long statement and the artificially colored product with an intermediate statement. Males were more likely to purchase the product with the long statement and females were both more and less likely to purchase the product with the intermediate statement. For both statements, males rated the products as more natural and females rated the products as less natural. There were significant generational differences for likelihood of purchase for all products except for the naturally colored products with short statements and the product with a short statement and artificial color in the middle. Younger generations, specifically the Millennials, were more likely to purchase and older generations, specifically the Silent Generation, were less likely to purchase. Fewer generational differences were seen for
perceptions of naturalness. The products with long statements and the artificially colored product 
with an intermediate statement were the only products with significant differences by age group. 
Millennials perceived these products to be more natural than the rest of the generational brackets. 
In general, respondents with higher levels of education and higher annual income were more 
likely to purchase and rated products as more natural, regardless of statement length and source 
of color. Not all of these differences were significant, however. Parents were also more likely to 
purchase, regardless of statement length or colorant source, although the differences were not 
always significant. Race/ethnicity was not a good predictor of purchase intent or perceptions of 
naturalness. Frequency of statement use, importance of color/flavor source, and purchase habits 
based on artificial colors/flavors were also not strong predictors of likelihood of purchase or 
perceived naturalness.

UK respondents who frequently consume Toaster Pastries, Hard Candy, Cookies, Ice 
Cream, Popsicles, Flavored Gelatin, Chewing Gum, Breath Mints, Flavored Crackers, Salad 
Dressing, Fruit Yogurt, Fruit Juice, Soda, Energy Drinks, and Sports drinks were more likely to 
purchase and had higher perceptions of naturalness. Many of these differences were significant, 
but there were few significant differences for likelihood to purchase for the product with a short 
statement and natural color in the middle and few significant differences for perceptions of 
naturalness for the naturally colored product with an intermediate statement and the products 
with short statements. There were no significant differences in purchase behavior with 
consumption of breakfast cereal and no significant differences in perceptions of naturalness for 
all products but the artificially colored product with a long statement for consumption of 
breakfast cereal.
Forty-six percent of UK respondents believe that artificial colors are harmful for health and 45% believe that artificial flavors are harmful for health. Respondents who agree that artificially colored and flavored foods are *not* harmful for health had significantly higher perceptions of naturalness for all products except for the naturally colored product with an intermediate statement, the product with a short statement and artificial color in the middle (only for flavor), the product with a short statement and natural color in the middle, and the product with a short statement and natural color at the end (only for color). They were also significantly more likely to purchase all products, but there was no significant difference for the product with a short statement and natural color listed in the middle. Those who agree that they try to eat foods that do not contain additives were more likely to purchase the naturally colored products, but there were no significant differences for perceptions of naturalness. Respondents who agreed that they would like to eat only organic vegetables were more likely to purchase all products and perceived all products, except for the artificially colored product with a short statement, as natural. Participants who agree that they only look for non-GMO ingredients in the foods they eat and always look for natural ingredients in the snack foods they eat are more likely to purchase the naturally colored products with short statements and the product with a short statement and artificial color at the end.

None of the CATA statements were selected by more than 49% of the UK respondents. The products with long statements were associated with “Too long”, “Has chemical names”, “Contains unnatural ingredients”, “Don’t recognize ingredients”, “Ingredients made in a lab”, “Extra flavor added” and “Has unhealthy ingredients”. The artificially colored product with a long statement was also associated with “Extra color added”. All of the artificially colored products were associated with “Has artificial colors”, and “Extra color added”. The artificially
colored products with long and intermediate statements were also associated with “Has unhealthy ingredients”. All four of the naturally colored products shared no common associations. However, the naturally colored products with intermediate and short statements were associated with “Has natural colors”, “Ingredients come from nature”, and “Has healthy ingredients”. No more than 18% of UK respondents selected “Food sounds tasty”, “Food sounds gross”, “Not appropriate for kids”, and “Too short”. No more than 7% of respondents selected “Ingredients cause ADD/ADHD”, “I believe I am sensitive to one or more of these ingredients”, “Ingredients cause cancer”, and “I have a diagnosed allergy to one or more of the ingredients”.

**Australia**

As with the US and UK respondents, ingredient statement length had the greatest impact on purchase behavior and perceptions of naturalness. Australian respondents were significantly more likely to purchase products represented by short ingredient statements than those represented by intermediate and long ingredient statements (Figures 2-1 and 2-2). They gave higher scores to perceived naturalness than they did to likelihood to purchase for these products. Similarly, they perceived these products as significantly more natural than the products with intermediate and long ingredient statements. The products with long ingredient statements were the least likely to be purchased and were perceived as the least natural. Australian respondents gave higher scores for likelihood to purchase than they did to perceived naturalness for the products represented by long statements. The products represented by intermediate statements were more similar in likelihood to purchase and perceived naturalness to the products with long statements than they were to the products with short ingredient statements.
Australians were more likely to purchase and had higher perceptions of naturalness for the naturally colored products with short and intermediate statements (Figures 2-1 and 2-2). They were slightly more likely to purchase the artificially colored product represented by the long statement and perceived this product to be significantly more natural than its naturally colored counterpart. The product with a short statement and the natural color listed in the middle was significantly more likely to be purchased and perceived as significantly more natural than the product with natural color listed at the end. There was no significant difference, however, between the two products with short statements and artificial colors. There was also no significant difference in purchase behavior between the products represented by short statements with natural color listed in the middle and artificial colors listed at the end. The naturally colored product with an intermediate statement and the artificially colored product with a long statement were perceived as significantly more natural than their counterparts were. There was no significant difference between the artificially and naturally colored products with intermediate and long statements for likelihood to purchase.

There were significant gender differences in likelihood to purchase and perceptions of naturalness for all products except for the naturally colored products with short statements and the naturally colored product with an intermediate statement. Male respondents were more likely to purchase and perceived the products as more natural compared to female respondents. There were significant generational differences for likelihood to purchase for all products except the natural colored intermediate product and naturally colored products with short statements. There were significant generational differences in naturalness perceptions for the products with long statements and the artificially colored product with an intermediate statement. Millennials and Centennials were more likely to purchase the products with long statements, artificially colored
product with an intermediate statement, and artificially colored products with short statements. The Baby Boomers and Silent Generation were the least likely to purchase these statements. Younger participants perceived the artificially colored product with a long statement as natural and older participants perceived this product as less natural. Younger participants and the Silent Generation perceived the naturally colored product with a long statement and the artificially colored intermediate statement to be more natural and Gen X and the Boomers perceived the naturally colored long statement as less natural. There were no significant generational differences in perceptions of naturalness for the four short statements and the naturally colored intermediate statement. In general, participants with more education were more likely to purchase and perceived the statements as more natural, although these differences were often not significant. Participants who reported that the source of color/flavor were important to them were less likely to purchase the long statements and the artificially colored statements and more likely to purchase the short and naturally colored statements, although not all these differences were significant. No trends were seen with perceptions of naturalness. Participants who were more likely not to purchase foods with artificially colors/flavors perceived the intermediate, short, and artificially colored long statements as more natural. Race, income, and number of children in the household were not good predictors of likelihood to purchase and perceptions of naturalness and not many significant differences existed between demographic groups. Frequency of reading ingredient statements was also not a good predictor and there were not many significant differences.

Australian respondents who frequently ate Toaster Pastries, Hard Candy, Cookies, Ice Cream, Popsicles, Flavored Gelatin, Chewing Gum, Breath Mints, Breakfast Cereal, Flavored Crackers, Salad Dressing, Fruit Yogurt, Fruit Juice, Soda, Energy Drinks, and Sports Drinks
were significantly more likely to purchase and perceived the products as more natural. There were few significant differences for the naturally colored short statements for purchase behavior and few significant differences for the naturally colored intermediate statement and all products with short statements for perceptions of naturalness.

Respondents who agree that artificial colors and flavors are not harmful for health were significantly more likely to purchase all statements. They also had significantly higher perceptions of naturalness. There were no significant differences in perceptions of naturalness for the naturally colored product with an intermediate statement (just for flavor) and the product with a short statement and natural color listed in the middle. However, 57% believe that artificial colors are harmful for health and 58% believe that artificial flavors are harmful for health. The statements “I try to eat foods that do not contain additives”, “I would like to eat only organically grown vegetables”, and “I always look for natural ingredients in the snack foods that I eat” were not a great predictors of purchase behavior and perceptions of naturalness. There were no significant differences for purchase behavior and perceptions of naturalness for the statement “I look for only non-GMO ingredients in the food I eat”.

Of the CATA items relating to each ingredient statement, only two of the options were selected by more than 50% of the Australian respondents. “Has artificial colors” was selected by more than 50% of respondents for the artificially colored products with long and intermediate statements and “Has natural colors” was selected by more than “50%” for the naturally colored products with short statements. The products with long statements were associated with “Too long”, “Has chemical names”, “Contains unnatural ingredients”, “Has unhealthy ingredients”, “Don’t recognize ingredients” and “Extra flavor added”. The artificially colored product with a long statement was also associated with “Ingredients made in a lab”. The artificially colored
products were associated with “Has artificial colors” and “Extra color added”. The artificially colored products with long and intermediate statements were associated with “Contains unnatural ingredients” and “Has unhealthy ingredients”. Between the artificially colored products with short statements, the product with the color in the middle was also associated with “Ingredients come from nature” and “Has healthy ingredients”. All four naturally colored products were associated with “Has natural colors”. The naturally colored products with intermediate and short statements were also associated with “Ingredients come from nature” and “Has healthy ingredients”. No more than 22% of Australian respondents chose “Food sounds tasty” and “Not appropriate for kids”. No more than 18% chose “Food sounds gross”, “Too short”, and “I believe I am sensitive to one or more of these ingredients”. Finally, no more than 10% of respondents chose “Ingredients cause ADD/ADHD”, “Ingredients cause cancer” and “I have a diagnosed allergy to one or more of the ingredients”.

Cross Country Comparisons

Between the three countries/regions, respondents from the United States were more likely to purchase the products represented by each statement. The products represented by short ingredient statements with natural color were the most likely to be purchased in every country. There were no significant differences between the two products with short ingredient statements and natural color, however. The products with long ingredient statements were the least likely to be purchased, although participants from the United States were more likely to purchase both of these products than UK or Australian respondents. Between the two, the naturally colored product with a long statement was the least likely to be purchased. Respondents from the UK and Australia were more likely to purchase the naturally colored product with an intermediate
statement than the product with a short statement and artificial color listed at the end. Likelihood of purchase was higher for the products short statements and color in the middle of the statement compared to when the colorant was listed at the end of the statement.

American participants gave higher average natural ratings for each product and the Australian participants gave lower average natural ratings for each product, though these differences were not always significant. Overall, the natural versions of each product received higher naturalness scores than their artificial counterparts. The products with short ingredient statements and natural color received the highest naturalness scores. The products with short ingredient statements and color in the middle were rated as more natural than the products with short ingredient statements and color at the end of the statement. All three countries gave higher naturalness scores to the product with an intermediate statement with natural color than the product with a short ingredient statement and artificial color located at the end of the statement. This difference in scores was significant for UK and Australian respondents, but not for Americans. All three countries rated the product with a long statement and artificial color as the least natural. Participants from the UK and Australia rated the product with a long ingredient statement and natural colors as slightly more natural than the artificially colored product with an intermediate statement, although this difference was not significant.

Between the three regions, Americans were more likely to purchase and perceived product as more natural than respondents from the UK and Australia. In addition, Australians gave the lowest naturalness scores. The long and intermediate statements were taken from products commonly found in the United States. Though these ingredient names were not shown, there is a possibility that American respondents were unconsciously more familiar with these ingredient statements and/or the format of the ingredient label. Some of the ingredient statements
used in this survey came from products that are sold in markets all over the world (Cheetos and M&M’s®, for example). The differences in purchase behavior and perceptions of naturalness could also be due to skepticism of processed foods. Abrams and Meyers found that consumers were suspicious of the “Natural” claim on foods and though respondents were not exposed to this claim (with the exception of “Natural color”), this same wariness may still be involved (Abrams, 2010). The lack of identifying information could also contribute to the skepticism. Binninger found that “Natural” packaging influence consumer perceptions of a product’s naturalness (Binninger, 2017). Consumers from different countries may rely more heavily on external cues when making decisions about purchasing or the naturalness of a given food or beverage. Therefore, Australian and UK respondents may be less willing to purchase products without a product name or picture.

Perceptions of the statements were similar across the three regions. Between the three regions, generally, Australians had a higher frequency of selection of the various CATA items compared to the US and UK. Participants from all regions associated the long ingredient statements with being too long, having chemical names, containing unnatural ingredients, containing unhealthy ingredients, and they did not recognize some of the ingredients. These statements, more so than the others, had more ingredients with chemical names. They also contained more additives than the others, leading to perceptions about poor health and unnatural ingredients. Americans had relatively high frequencies for the statement “Has healthy ingredients”, which could indicate that Americans associate health related benefits to more ingredients than UK or Australian consumers. The artificially colored statements had high associations with “Contains artificial colors” and the naturally colored statements had high associations with “Contains natural colors”. Australian respondents were more sensitive to the
presence of artificial colors and selected this item for the artificially colored statements more frequently than respondents from the US or UK. They also had higher frequencies for “Extra color added” and “Extra flavor added” for most statements. This, combined with the lowest perceptions of naturalness, could indicate that Australian consumers are more particular about ingredient statements than consumers from the US or UK. All three countries had similar frequencies of selection for the sources of color in each statement. The intermediate and short naturally colored statements were thought to have healthy ingredients and ingredients that come from nature. These statements had less than five ingredients, all of which were commonly named as opposed to having chemical names. The long naturally colored statement had more in common with the artificially colored long and intermediate statement than it did with the intermediate and short naturally colored statements. This supports the conclusion that long ingredient statements can have a negative impact on consumer perceptions of a food or beverage.

When the source of color was clearly called out in the statement (for example, “Color”, “Artificial Colors”, “Natural Colors”, “Red 40”) respondents from all three regions had high frequency of selection. Ingredients from plants were also frequently selected, but not to the same degree. Ingredients such as Tomato Powder, Red and Green Bell Pepper Powder, Carrot Juice Concentrate, Sweet Potato Juice Concentrate, and Pear Juice Concentrate were frequently selected, but by not nearly as many people. Milk Chocolate, Cinnamon, and Cocoa were also selected as sources of color. All ingredients were selected by at least 25 people. Interestingly, ingredients like Water, Salt, and Baking Powder were selected as sources of color, though only by a small percentage of respondents. Australians selected these types of ingredients less frequently than respondents from the US or UK. American respondents selected cheese based
ingredients more frequently than respondents from the UK or Australia. Respondents from the
UK selected “Spices” more frequently than respondents from the US or Australia.

Table 2-3. Likelihood to purchase and perceptions of naturalness of products represented by blind ingredient statements, of varying length, with either natural or artificial colors.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Country /Region</th>
<th>Likelihood to Purchase</th>
<th>Naturalness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short, Natural, Middle</td>
<td>US</td>
<td>6.12&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6.94&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>UK</td>
<td>5.90&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>6.72&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>AUS</td>
<td>6.10&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6.63&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Short, Natural, End</td>
<td>US</td>
<td>6.02&lt;sup&gt;a&lt;/sup&gt;</td>
<td>6.72&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>UK</td>
<td>5.79&lt;sup&gt;abc&lt;/sup&gt;</td>
<td>6.58&lt;sup&gt;bc&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>AUS</td>
<td>5.78&lt;sup&gt;abc&lt;/sup&gt;</td>
<td>6.31&lt;sup&gt;cd&lt;/sup&gt;</td>
</tr>
<tr>
<td>Short, Artificial, Middle</td>
<td>UK</td>
<td>5.81&lt;sup&gt;abc&lt;/sup&gt;</td>
<td>6.14&lt;sup&gt;de&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>AUS</td>
<td>5.57&lt;sup&gt;bcd&lt;/sup&gt;</td>
<td>5.77&lt;sup&gt;f&lt;/sup&gt;</td>
</tr>
<tr>
<td>Short, Artificial, End</td>
<td>UK</td>
<td>4.87&lt;sup&gt;hij&lt;/sup&gt;</td>
<td>5.36&lt;sup&gt;gh&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>AUS</td>
<td>4.98&lt;sup&gt;ghi&lt;/sup&gt;</td>
<td>5.23&lt;sup&gt;h&lt;/sup&gt;</td>
</tr>
<tr>
<td>Intermediate, Natural</td>
<td>UK</td>
<td>5.50&lt;sup&gt;cde&lt;/sup&gt;</td>
<td>5.90&lt;sup&gt;ef&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>AUS</td>
<td>5.36&lt;sup&gt;def&lt;/sup&gt;</td>
<td>5.68&lt;sup&gt;fg&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>US</td>
<td>5.39&lt;sup&gt;def&lt;/sup&gt;</td>
<td>4.79&lt;sup&gt;i&lt;/sup&gt;</td>
</tr>
<tr>
<td>Intermediate, Artificial</td>
<td>UK</td>
<td>4.80&lt;sup&gt;hijk&lt;/sup&gt;</td>
<td>4.37&lt;sup&gt;ijkl&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>AUS</td>
<td>4.94&lt;sup&gt;ghij&lt;/sup&gt;</td>
<td>4.34&lt;sup&gt;ijkl&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>US</td>
<td>5.02&lt;sup&gt;fgh&lt;/sup&gt;</td>
<td>4.57&lt;sup&gt;ij&lt;/sup&gt;</td>
</tr>
<tr>
<td>Long, Natural</td>
<td>UK</td>
<td>4.49&lt;sup&gt;k&lt;/sup&gt;</td>
<td>4.44&lt;sup&gt;ijk&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>AUS</td>
<td>4.61&lt;sup&gt;jk&lt;/sup&gt;</td>
<td>4.41&lt;sup&gt;kl&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>US</td>
<td>5.15&lt;sup&gt;efgh&lt;/sup&gt;</td>
<td>4.19&lt;sup&gt;klm&lt;/sup&gt;</td>
</tr>
<tr>
<td>Long, Artificial</td>
<td>UK</td>
<td>4.74&lt;sup&gt;ijk&lt;/sup&gt;</td>
<td>4.10&lt;sup&gt;lm&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>AUS</td>
<td>4.66&lt;sup&gt;ijk&lt;/sup&gt;</td>
<td>3.86&lt;sup&gt;m&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

*Different letters indicated significant differences at p≤0.05
Table 2-4. Associations of US, UK, and AUS respondents with products represented by long ingredient statements.

<table>
<thead>
<tr>
<th>Statements</th>
<th>Long, Artificial Color</th>
<th></th>
<th>Long, Natural Color</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>USA</td>
<td>UK</td>
<td>AUS</td>
<td>USA</td>
</tr>
<tr>
<td>Too Long</td>
<td>35%</td>
<td>33%</td>
<td>30%</td>
<td>31%</td>
</tr>
<tr>
<td>Has artificial colors</td>
<td>49%</td>
<td>47%</td>
<td>56%</td>
<td>18%</td>
</tr>
<tr>
<td>Too short</td>
<td>3%</td>
<td>1%</td>
<td>1%</td>
<td>3%</td>
</tr>
<tr>
<td>Has chemical names</td>
<td>42%</td>
<td>41%</td>
<td>46%</td>
<td>39%</td>
</tr>
<tr>
<td>I have a diagnosed allergy to one or more of the ingredients</td>
<td>3%</td>
<td>2%</td>
<td>5%</td>
<td>5%</td>
</tr>
<tr>
<td>Has natural colors</td>
<td>12%</td>
<td>8%</td>
<td>9%</td>
<td>23%</td>
</tr>
<tr>
<td>Food sounds gross</td>
<td>14%</td>
<td>16%</td>
<td>18%</td>
<td>14%</td>
</tr>
<tr>
<td>Food sounds tasty</td>
<td>18%</td>
<td>12%</td>
<td>16%</td>
<td>13%</td>
</tr>
<tr>
<td>Contains unnatural ingredients</td>
<td>37%</td>
<td>38%</td>
<td>45%</td>
<td>28%</td>
</tr>
<tr>
<td>Ingredients come from nature</td>
<td>13%</td>
<td>13%</td>
<td>11%</td>
<td>16%</td>
</tr>
<tr>
<td>Ingredients made in a lab</td>
<td>23%</td>
<td>23%</td>
<td>29%</td>
<td>22%</td>
</tr>
<tr>
<td>Has unhealthy ingredients</td>
<td>34%</td>
<td>35%</td>
<td>39%</td>
<td>27%</td>
</tr>
<tr>
<td>Ingredients cause cancer</td>
<td>9%</td>
<td>6%</td>
<td>10%</td>
<td>7%</td>
</tr>
<tr>
<td>Has healthy ingredients</td>
<td>19%</td>
<td>14%</td>
<td>15%</td>
<td>23%</td>
</tr>
<tr>
<td>Not appropriate for kids</td>
<td>12%</td>
<td>17%</td>
<td>22%</td>
<td>10%</td>
</tr>
<tr>
<td>Don't recognize ingredients</td>
<td>25%</td>
<td>30%</td>
<td>29%</td>
<td>33%</td>
</tr>
<tr>
<td>Extra color added</td>
<td>37%</td>
<td>39%</td>
<td>44%</td>
<td>16%</td>
</tr>
<tr>
<td>Extra flavor added</td>
<td>33%</td>
<td>37%</td>
<td>47%</td>
<td>23%</td>
</tr>
<tr>
<td>Ingredients cause Attention Deficit/Attention Deficit Hyper Disorder (ADHD)</td>
<td>5%</td>
<td>7%</td>
<td>10%</td>
<td>5%</td>
</tr>
<tr>
<td>I believe I am sensitive to one or more of these ingredients</td>
<td>9%</td>
<td>6%</td>
<td>11%</td>
<td>6%</td>
</tr>
</tbody>
</table>
Table 2-5. Associations of US, UK, and AUS respondents with products represented by intermediate ingredient statements.

<table>
<thead>
<tr>
<th>Statements</th>
<th>Intermediate, Artificial Color</th>
<th>Intermediate, Natural Color</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>USA</td>
<td>UK</td>
</tr>
<tr>
<td>Too Long</td>
<td>8%</td>
<td>8%</td>
</tr>
<tr>
<td>Has artificial colors</td>
<td>44%</td>
<td>45%</td>
</tr>
<tr>
<td>Too short</td>
<td>5%</td>
<td>3%</td>
</tr>
<tr>
<td>Has chemical names</td>
<td>21%</td>
<td>25%</td>
</tr>
<tr>
<td>I have a diagnosed allergy to one or more of the ingredients</td>
<td>5%</td>
<td>2%</td>
</tr>
<tr>
<td>Has natural colors</td>
<td>11%</td>
<td>11%</td>
</tr>
<tr>
<td>Food sounds gross</td>
<td>7%</td>
<td>8%</td>
</tr>
<tr>
<td>Food sounds tasty</td>
<td>28%</td>
<td>18%</td>
</tr>
<tr>
<td>Contains unnatural ingredients</td>
<td>25%</td>
<td>25%</td>
</tr>
<tr>
<td>Ingredients come from nature</td>
<td>15%</td>
<td>11%</td>
</tr>
<tr>
<td>Ingredients made in a lab</td>
<td>14%</td>
<td>17%</td>
</tr>
<tr>
<td>Has unhealthy ingredients</td>
<td>25%</td>
<td>28%</td>
</tr>
<tr>
<td>Ingredients cause cancer</td>
<td>6%</td>
<td>3%</td>
</tr>
<tr>
<td>Has healthy ingredients</td>
<td>16%</td>
<td>8%</td>
</tr>
<tr>
<td>Not appropriate for kids</td>
<td>7%</td>
<td>12%</td>
</tr>
<tr>
<td>Don't recognize ingredients</td>
<td>14%</td>
<td>22%</td>
</tr>
<tr>
<td>Extra color added</td>
<td>39%</td>
<td>38%</td>
</tr>
<tr>
<td>Extra flavor added</td>
<td>21%</td>
<td>17%</td>
</tr>
<tr>
<td>Ingredients cause Attention Deficit (ADD)/Attention Deficit Hyper Disorder (ADHD)</td>
<td>6%</td>
<td>7%</td>
</tr>
<tr>
<td>I believe I am sensitive to one or more of these ingredients</td>
<td>5%</td>
<td>4%</td>
</tr>
</tbody>
</table>
Table 2-6. Associations of US, UK, and AUS respondents with products represented by short ingredient statements.

<table>
<thead>
<tr>
<th>Statements</th>
<th>Short, Artificial Color, Middle</th>
<th>Short, Artificial Color, End</th>
<th>Short, Natural Color, Middle</th>
<th>Short, Natural Color, End</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>USA</td>
<td>UK</td>
<td>AUS</td>
<td>USA</td>
</tr>
<tr>
<td>Too Long</td>
<td>2%</td>
<td>2%</td>
<td>2%</td>
<td>3%</td>
</tr>
<tr>
<td>Has artificial colors</td>
<td>33%</td>
<td>33%</td>
<td>36%</td>
<td>35%</td>
</tr>
<tr>
<td>Too short</td>
<td>15%</td>
<td>14%</td>
<td>11%</td>
<td>18%</td>
</tr>
<tr>
<td>Has chemical names</td>
<td>8%</td>
<td>7%</td>
<td>8%</td>
<td>7%</td>
</tr>
<tr>
<td>I have a diagnosed allergy to one or more of the ingredients</td>
<td>3%</td>
<td>2%</td>
<td>2%</td>
<td>2%</td>
</tr>
<tr>
<td>Has natural colors</td>
<td>14%</td>
<td>10%</td>
<td>13%</td>
<td>11%</td>
</tr>
<tr>
<td>Food sounds gross</td>
<td>7%</td>
<td>4%</td>
<td>5%</td>
<td>9%</td>
</tr>
<tr>
<td>Food sounds tasty</td>
<td>21%</td>
<td>13%</td>
<td>19%</td>
<td>15%</td>
</tr>
<tr>
<td>Contains unnatural ingredients</td>
<td>11%</td>
<td>11%</td>
<td>12%</td>
<td>11%</td>
</tr>
<tr>
<td>Ingredients come from nature</td>
<td>25%</td>
<td>25%</td>
<td>29%</td>
<td>23%</td>
</tr>
<tr>
<td>Ingredients made in a lab</td>
<td>8%</td>
<td>7%</td>
<td>8%</td>
<td>9%</td>
</tr>
<tr>
<td>Has unhealthy ingredients</td>
<td>11%</td>
<td>9%</td>
<td>13%</td>
<td>13%</td>
</tr>
<tr>
<td>Ingredients cause cancer</td>
<td>4%</td>
<td>2%</td>
<td>2%</td>
<td>4%</td>
</tr>
<tr>
<td>Has healthy ingredients</td>
<td>31%</td>
<td>26%</td>
<td>29%</td>
<td>25%</td>
</tr>
<tr>
<td>Not appropriate for kids</td>
<td>4%</td>
<td>4%</td>
<td>6%</td>
<td>6%</td>
</tr>
<tr>
<td>Don't recognize ingredients</td>
<td>5%</td>
<td>7%</td>
<td>7%</td>
<td>4%</td>
</tr>
<tr>
<td>Extra color added</td>
<td>32%</td>
<td>33%</td>
<td>35%</td>
<td>34%</td>
</tr>
<tr>
<td>Extra flavor added</td>
<td>8%</td>
<td>7%</td>
<td>9%</td>
<td>12%</td>
</tr>
<tr>
<td>Ingredients cause Attention Deficit Disorder (ADD)/Attention Deficit Hyper Disorder (ADHD)</td>
<td>5%</td>
<td>3%</td>
<td>4%</td>
<td>3%</td>
</tr>
<tr>
<td>I believe I am sensitive to one or more of these ingredients</td>
<td>4%</td>
<td>3%</td>
<td>4%</td>
<td>4%</td>
</tr>
</tbody>
</table>
Figure 2-1. Percentage of US, UK, and AUS participants who are likely or unlikely to purchase products represented by ingredients statements of various lengths.
Figure 2-2. Percentage of US, UK, and AUS participants who rated products represented by ingredients statements of various lengths as natural or unnatural.
General Discussion

Results from all three regions indicates that the length of an ingredient statement and the positioning of certain ingredients within the statement impact purchase behavior and perceptions of naturalness. Across the board, the short ingredient statement with natural color listed in the middle was the most likely to be purchase and was perceived as the most natural. Nielsen reported that 50% of respondents from Europe and 61% from North America believe that a shorter ingredient statement indicates a healthier product (Nielsen, 2016). The results from this study indicate that shorter ingredient statements also influence perceptions of naturalness. The ingredients contained within the statement also have an effect. Respondents from all three countries were less likely to purchase the naturally colored long statement than the artificially colored long statement. This is likely due to the presence of other ingredients in the former statement. The artificially colored statement had ingredients like cheese, natural and artificial flavors, spices, and vegetable derived ingredients (Maltodextrin from corn, tomato powder, red and green bell pepper powder), whereas the naturally colored statement had ingredients like bleached flour, oils with TBHQ, Calcium Stearoyl Lactylate, and Amylase Enzymes. Chambers et al. found that ingredients affect perceptions of naturalness and ingredients with chemical names were perceived to be the least natural (Chambers, 2018). In this case, the overall ingredient list had the greatest impact on purchase behavior. However, the same cannot be said for perceptions of naturalness. Respondents indicated that the artificially colored long statement was less natural than the naturally colored long statement. The presence of natural colors was more influential on perceptions naturalness than the rest of the ingredients in the statement.

The location of ingredients within the statement also appears to have an impact on consumer perceptions and buying behavior. An ingredient listed in the last position on an ingredient
statement is the ingredient that makes up the smallest percentage of the formula. This may not be common knowledge to consumers, however, and statements with a greater percentage of color additives in the formulation were perceived to be more natural and were more likely to be purchased. A reason for this could be related to consumers’ attention. The statements with natural or artificial colors listed at the end draw more attention to the source of color though it makes up a smaller percentage of the formula. Thirty-nine percent of American respondents, 28% of UK respondents, and 36% of Australian respondents report that they always or most of the time read ingredient statements. However, 49% of American respondents, 53% of UK respondents, and 49% of Australian respondents report that they sometime or never pay attention to the source of color on ingredient statements. With the percentage of those that read statements relatively low and even lower for those that focus on the source of color, it is likely that consumer attention is drawn to the source of color, influencing their perceptions of the product.

Taylor and Stevenson found that people associated natural food consumers with being more feminine, more educated wealthier, and older (Taylor, 2018). In their review, Román et al. also found that female and older consumers were more receptive to natural foods and Bäckstrom found that females are more receptive to natural foods (Roman, 2017; Backstrom 2004). This study found that, generally, wealthier and more educated respondents had higher perceptions of naturalness, supporting the conclusion made by Taylor and Stevenson. However, males and younger respondents had higher perceptions of naturalness. This could be due to skepticism on the part of female respondents and respondents from older generations. If they are indeed more receptive to natural food products, they may be less willing to rate a product as natural without additional product information. Males and those from younger generations may be more comfortable making a decision with less information.
Limitations

There were some limitations with this study. Only eight ingredient statements were used, with only two being used for the long and intermediate statements. The major difference between the two was the source of color. More research could be done studying other differences such as the impact of plant-based ingredients or novel ingredients on perceptions of naturalness when only the ingredient statement is shown. Additionally, this study only looked at three, English-speaking regions. Further research is needed to understand the influence of ingredient statement length and presence of artificial/natural colors on Latin American, African, Asian, and other European consumer perceptions of naturalness.

Conclusion

Respondents from the United States, United Kingdom, and Australia were influenced by both the length of ingredient statements and the location of specific ingredients within the statement. Shorter ingredient statements were more likely to be purchased and were perceived as more natural than longer ingredient statements. When color additives were located at the end of the short statements, they were perceived as less natural and were less likely to be purchased than when the colorant was listed in the middle of the statement. This is interesting considering that the latter statements have a greater percentage of colorant in their formulation, yet were perceived to be more natural. The long ingredient statement with natural color was less likely to be purchased and perceived as less natural than the long ingredient statement with artificial colors. This result may be due to the high volume of ingredients with chemical names in the naturally colored statement. Americans were the most likely to purchase and gave higher average naturalness scores and Australians gave lower average naturalness scores. Of the studied
demographics, gender and age were the best predictors of buying behavior and natural
perceptions. Generally, males and younger generations (specifically the Millennials) were the
most likely to purchase and perceived the statements to be more natural than other groups in
those demographics. Respondents associated longer ingredient statements with containing
unnatural and unhealthy ingredients and the shorter, naturally colored statements with having
natural and healthy ingredients. Respondents also correctly identified sources of color in each
statement, especially if they were clearly labeled, and indicated that other plant based
ingredients, cheese based ingredients, and indulgent ingredients were sources of color. Further
research can be conducted with more ingredient statements to validate the conclusion from this
study and to understand perceptions in non-English speaking countries.

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internet samples.* In M. Trotman (Ed.), The challenges of a changing world. Proceedings
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Department of Health and Human Services; Use of the Term “Natural” in the Labeling of Human Food Products; Request for Information and Comments. 80 Fed. Reg. 69905 (November 12, 2015) (to be codified at 21 C.F.R. Part 101).


Chapter 3 - The Influence of Colorants, Flavorants, and Product Identity on Perceptions of Naturalness

Abstract

Natural foods are important to consumers, yet frustrating to producers due to the lack of a formal definition. Previous work has studied how consumers define naturalness and how they rate the naturalness of various products, but there is a gap in knowledge relating to how color and flavor additives are perceived. With this in mind, the objective of this study was to understand how colorants and flavorants on ingredient statements affect perceptions of naturalness. An online survey was launched in the United States, United Kingdom, and Australia to determine how consumer perceive products with ingredient statement containing different combinations of artificial and natural colors and flavors when shown with and without the product identity. Results showed that consumers look at the whole product primarily to make decisions about naturalness, but also consider other factors. Products derived from plants and products with natural colors and flavors were found to be the most natural. Artificial flavors may be more acceptable than artificial colors due to negative health perceptions and labeling rules associated with colors. Additionally, factors like ingredient familiarity and processing likely influence consumers when making decisions about product naturalness. There were not large differences between the three regions. Males, Millennials, participants with more education, and participants who do not believe artificial colors and flavors have negative health effects have higher naturalness scores than other participants in their respective demographics. This information not only supports prior conclusions made about naturalness, but also furthers understanding about the topic, allowing academics and food producers to form a more complete picture about what naturalness really means.
Introduction

As previously mentioned in Chapter 2, the U.S. Department of Agriculture and Food and Drug Administration are responsible for food labeling in the United States. The USDA is responsible for labeling on meat, poultry, and egg products, whereas the FDA is responsible for labeling on all other food and beverage products. Ingredients are listed on the statement in descending order by weight with the ingredients listed at the end comprising the smallest percentage of the total formula (CFR, 2018). For most ingredients, the common name is listed on the statement. Colors can be listed by their specific names, like FD&C Yellow No. 5 or just Yellow 5, if they are certified colors or listed by their common names, like Vegetable Juice for Color or natural color, if they are non-certified colors. Flavors are listed as “artificial flavor” and/or “natural flavor” on ingredient statements (Center for Food Safety and Applied Nutrition, 2013). Previous research has been conducted on consumer perceptions of food labels. This work include use of and beliefs about nutrition labels, effect of product name and descriptions on perception, influence of nutrition labeling on expectations and sensory perceptions, impact of label and ingredient claims on expectations of liking, effect of pictures and photographs on expectations and perceptions, and impact of organic certification logos on willingness to pay and preference (Campos, 2011; Piqueras-Fiszman, 2015; Schouteten, 2015; Janssen, 2012). Most of this work focuses on label claims and nutrition labels leaving the ingredient statement relatively unstudied.

Color and flavor additives are important and controversial ingredients used in many processed food and beverage products in the United States. According to the FDA, artificial flavor is “any substance, the function of which is to impart flavor, which is not derived from a spice, fruit or fruit juice, vegetable or vegetable juice, edible yeast, herb, bark, bud, root, leaf or
similar plant material, meat, fish, poultry, eggs, dairy products, or fermentation thereof” (CFR, 2018). They state that natural flavors come from essential oils, oleoresins, essences/extractives, protein hydrolysates, distillates, or products of roasting, heating, or enzymolysis containing flavor derived from the sources listed above in which artificial flavors cannot be derived (CFR, 2018). Colors, on the other hand, are only defined as color additives, which are dyes, pigments, or other substances that impart color (CFR Part 70, 2018).

There has been a large amount of work conducted on how food color influences perceptions of food and beverages. In a study from 1980, Dubose et al. added congruent and incongruent colors to fruit flavored beverages. They found that participants more frequently misidentified the flavor of the beverage when the color was incongruent with the flavor of the beverage. They also found that color intensity affected the flavor acceptance of colored beverages and colored cakes (Dubose, 1980). Similarly, Zampini found that people correctly identified the flavor of aqueous solutions more often when the color corresponded with their expectations. The lime solution was correctly identified more frequently when the solution was green or colorless, for example. Correct identification did not occur with strawberry, however. This occurs because colors tend to be associated with specific flavors. Orange color was associated with orange flavor, yellow with lemon flavor, and green with lime flavor. Associations for the color red, however, were more complex and participants related red to strawberry, raspberry, and cherry flavor (Zampini, 2007). Food color can also influence expectations prior to tasting. Zellner and Durlach found that brown colored lemon and mint beverages were expected to be less refreshing and clear beverages were expected to be more refreshing. Brown colored lemon and mint beverages were found to be less refreshing than other colors after tasting as well. The color of the beverage affected expectations of flavor intensity,
though there were fewer significant differences after tasting. They also found that color affects expectations of liking and actual liking (Zellner, 2003). Spence published a comprehensive review of color perceptions studies discussing the influence of color on basic taste and flavor perception, the influence of color on aroma perception, the influence of color on detection thresholds, the influence of color on flavor identification, and influence of color on expectations (Spence, 2010).

Research has also been conducted to study the relationship between artificial colors and health. When comparing artificial colors and sweeteners, participants perceived significantly more risks with colors (Bearth, 2014). Wąsowicz found that Polish consumers believe that unhealthy products contain artificial colors along with being high in fat and calories (Wąsowicz, 2015).

Compared to color additives, little work has been done to study how flavor additives affect perceptions. According to Nielsen, 62% and 61% of global respondents avoid artificial flavors and artificial colors, respectively (Nielsen, 2016). They also report that a lack of artificial colors and flavors and presence of natural flavors is important to global consumers when making purchasing decisions (Nielsen, 2015). Additionally, FONA reports that 69% of American consumers believe that products without artificial colors and flavors are more important than “natural” products (FONA, 2018). It is clear that color and flavor additives are important to consumers. Though there has been plenty of research studying how color affects perceptions, there is a gap in knowledge related to how color and flavor additives affect perceptions of product naturalness. Since there is no formal definition of natural, it is necessary for academics and product developers to get a better understanding of this vague term and how products with artificial and/or natural colors and flavors fit into the consumer definition. This research was
conducted to address this gap in knowledge. The objectives of this study were (1) to understand how products with artificial and/or natural colors and flavor additives affect consumer perceptions of naturalness and (2) to understand what consumers believe are appropriate sources of natural color and flavor additives.

Materials & Methods

A standardized online questionnaire was used by consumers in three countries: United States of America (USA), the United Kingdom (UK), and Australia (AUS) to gather data for this research.

Questionnaire

An online survey was launched using Qualtrics Survey Software (Provo, UT, USA) and participants were compensated using a reward system offered by Qualtrics. Participants were shown eight statements from four food products, each being shown twice. The first time the statement was shown, participants were only shown the ingredient statement with no other information and were asked to rate the naturalness of the food. Naturalness was rated on a 9-point scale anchored with “1 – Not At All Natural” and “9 – Extremely Natural”. After seeing all four statements, they were shown the same statements, this time being informed of the identity of the product. The four statement were chosen because they have different combinations of artificial and natural colors and flavors. Product ingredient statements included Strawberry Puree (Natural Color, Natural Flavor), Flamin’ Hot Cheetos® (Artificial Color, Natural Flavor), Gummy Candy (Artificial Color, Artificial Flavor), and Blueberry Yogurt (Natural Color, Artificial Flavor). In addition to these statements, participants were shown two check all that
apply (CATA) lists and were asked to select all the sources they believe that natural colors and natural flavors for food can come from. The questions included in the survey can be found in the appendix.

Respondents were also asked various demographic questions including gender, age, race/ethnicity (using race demographics commonly used in each country/region), education level, income (using income brackets commonly used in each country/region), and number of children. They were also asked how often they read ingredient statements, how often they pay attention to the source of coloring/flavors on labels, importance of color/flavor on the label, and likelihood to purchase based on the presence of artificial colors/artificial flavors. Participants were also asked how often they consume various foods from a list of foods that contain color additives, in CATA format. Items from the Health and Taste Attitudes Scale were included to further segment participants.

**Consumers**

One thousand participants from the United States, the United Kingdom, and Australia were recruited. Predominantly English speaking countries were chosen so that comparisons could be made within a common language, with slight variations in spelling and wording. Gender, age, and estimate of household grocery shopping were used to recruit participants. Three quotas were employed to recruit potential participants: gender (50% males, 50% females), age (20-25% for 18-23, 24-41, 42-52, and 53-73; 10% or less for 74 years or older), and estimate of household grocery shopping. Participants were not included if they were under 18 years of age or if they did less than 40% of the grocery shopping for their household. Age generations were used instead of traditional age brackets to form more accurate conclusions about perceptional
differences by age group. The generational groups, from youngest to oldest, were

Table 3-1. Demographic percentages*

<table>
<thead>
<tr>
<th>Demographic Characteristics</th>
<th>Categories</th>
<th>US</th>
<th>UK</th>
<th>AUS</th>
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<tbody>
<tr>
<td>Gender</td>
<td>Male</td>
<td>48%</td>
<td>50%</td>
<td>48%</td>
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<tr>
<td></td>
<td>Female</td>
<td>52%</td>
<td>50%</td>
<td>52%</td>
</tr>
<tr>
<td>Age</td>
<td>Centennials/Gen Z</td>
<td>25%</td>
<td>15%</td>
<td>14%</td>
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<tr>
<td></td>
<td>Millennials/Gen Y</td>
<td>18%</td>
<td>23%</td>
<td>24%</td>
</tr>
<tr>
<td></td>
<td>Gen X</td>
<td>26%</td>
<td>26%</td>
<td>26%</td>
</tr>
<tr>
<td></td>
<td>Baby Boomers</td>
<td>20%</td>
<td>26%</td>
<td>26%</td>
</tr>
<tr>
<td></td>
<td>Silent Generation</td>
<td>11%</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>Race/Ethnicity</td>
<td>American Indian/Alaska Native</td>
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<td></td>
<td></td>
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<td></td>
<td>Asian</td>
<td>4%</td>
<td>5%</td>
<td>12%</td>
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<td>Black/African/Caribbean</td>
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<td>1%</td>
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<td>Hispanic/Latino</td>
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<td>Caucasian/White</td>
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<td>1%</td>
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<td>Pacific Islander</td>
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<td></td>
<td>1%</td>
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<td>Other</td>
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<td>&lt;1%</td>
<td>1%</td>
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<td></td>
<td>Prefer Not to Answer</td>
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<td>2%</td>
<td>1%</td>
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<tr>
<td>Education</td>
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<td>34%</td>
<td>33%</td>
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<td>Associate Degree/Some College</td>
<td>32%</td>
<td>18%</td>
<td>25%</td>
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<td>College Degree</td>
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<td>27%</td>
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<td></td>
<td>Post Graduate</td>
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<td>13%</td>
<td>15%</td>
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<tr>
<td></td>
<td>Prefer Not to Answer</td>
<td>1%</td>
<td>2%</td>
<td>1%</td>
</tr>
<tr>
<td>Number of Children</td>
<td>No Children</td>
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<td>64%</td>
<td>63%</td>
</tr>
<tr>
<td></td>
<td>One Child</td>
<td>14%</td>
<td>16%</td>
<td>16%</td>
</tr>
<tr>
<td></td>
<td>Two Children</td>
<td>16%</td>
<td>14%</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td>Three Children</td>
<td>3%</td>
<td>5%</td>
<td>4%</td>
</tr>
<tr>
<td></td>
<td>Four or More Children</td>
<td>2%</td>
<td>1%</td>
<td>2%</td>
</tr>
</tbody>
</table>

* Percentages were based on 932, 959, and 969 respondents from the US, UK, and AUS, respectively.
Excel (Microsoft Office Pro ver. 2013) was used to calculate means and percentages, for descriptive statistics, and for chi-square tests for significance (p-values less than 5% were considered significant). XLSTAT (Addinsoft, New York, NY, USA) was used for Analysis of Variance and Correspondence Analysis for CATA data. Prior to analysis, 9-point scales were converted to 3-point scales to understand existing trends in perceptions. The scale was reduced to 1-Unnatural, Neither natural nor unnatural, and 3-Natural. Respondents with incomplete surveys were excluded before analysis. Some respondents are inattentive and may answer questions...
without thinking or simply check boxes without reading the question (Baker and Le Guin, 2007; Allen, 1966). Because of this, a fake or “cheater” question (e.g. Yang et al., 2015) was included in the survey. Participants who reported consuming ‘Live worms’ or ‘Pickled chicken’ in the past week were also excluded from the analysis. After exclusion, 969 respondents from Australia, 959 respondents from the UK, and 932 respondents from the US were included in the analysis.

**Results & Discussion**

**United States**

Both of the fruit based products were perceived as the most natural and were considered more natural when the product identity was revealed. Fifty-three percent of US respondents rated the Blueberry yogurt (Natural Color, Artificial Flavor) as natural (Figure 3-1). This result was not significantly different from the unidentified version of this statement, which was perceived as natural by 49% of respondents. There was also no significant difference between the unidentified Blueberry Yogurt and the identified Strawberry Puree (Natural Color, Natural Flavor), which was perceived as natural by 45% of respondents. Participants perceived the Puree to be less natural when unidentified and the percentage of natural ratings dropped to 38%. There was no significant difference between the unidentified Flamin’ Hot Cheetos® (Artificial Color, Natural Flavor) and the unidentified Gummy Candy (Artificial Color, Artificial Flavor), which were perceived as natural by 30% and 25% of respondents, respectively. The unidentified Gummy Candy were also not rated significantly different from the identified Flamin’ Hot Cheetos® and the identified Gummy Candy, which were both perceived as natural by 24% of American respondents.
All statements, whether identified or unidentified, were perceived to be more natural by males and less natural by females. Millennials also perceived all of the statements to be more natural than any other generational group. These differences were significant for every statement but the identified Blueberry Yogurt. Centennials, Silent Generation, and Baby Boomers generally rated all statements as less natural. Respondents with college or post-graduate degrees perceived the statements to more natural. These differences, however, were only significant for the unidentified Strawberry Puree, unidentified Gummy Candy, identified Cheetos, and identified Gummy Candy. Respondents with higher incomes also rated the statements as more natural, though these differences were not significant for the unidentified and identified Blueberry Yogurt statements. Parents perceived products as more natural than participants with no children. There was no significant difference, however, for the identified Blueberry Yogurt statement. Race was not a good predictor of naturalness perceptions and there were no significant differences for any statement.

American respondents who read ingredient statements more often when making purchases perceived the products to be more natural. Additionally, respondents who reported that they pay attention to the source of color and the source of flavor more often when making purchases perceived the products to be more natural. There were, however, no significant differences for the identified Yogurt for these three questions. Respondents who stated that the source of color and the source of flavor in foods and beverages was important perceived the products to be more natural. There were no significant difference for the unidentified Yogurt for flavor (though it contains artificial flavors) and no significant differences for the identified yogurt for color and flavor. Thirty-eight percent of respondents were likely not to purchase products with artificial colors and 37% were likely not to purchase products with artificial colors.
Despite this, these respondents perceived all of the products to be more natural than those whose purchase decisions are not affected by artificial colors and flavors.

Participants were also asked how frequently they consumed commonly colored and flavored foods. These foods include Toaster Pastries, Hard Candy, Cookies, Ice Cream, Popsicles, Flavored Gelatin, Chewing Gum, Breath Mints, Breakfast Cereal, Flavored Crackers, Salad Dressing, Fruit Yogurt, Fruit Juice, Soda, Energy Drinks, and Sports Drinks. Generally, participants who frequently consumed these products perceived the products as more natural.

There were significant differences for all of these foods/beverages for the unidentified Puree and the identified and unidentified Gummy Candy. There were no significant differences for Salad Dressing and Fruit Juice for the unidentified Cheetos; Ice Cream, Cereal, Dressing, and Soda for the unidentified Yogurt; Dressing for the identified Puree; Dressing and Juice for the identified Cheetos; and Ice Cream, Gum, Cereal, Dressing, Juice, and Soda for the identified Yogurt.

Frequency of Salad Dressing consumption was a poor predictor of naturalness ratings.

Respondents who agree that they are very particular about the healthiness of food perceived products as more natural. There were no significant differences for the unidentified Cheetos, identified Cheetos, and identified Yogurt statements. The former two were believed to be unnatural by most of the participants and the latter was perceived to be natural by most of the participants. Twenty-nine percent of respondents agree that artificially colored and artificially flavored foods are not harmful for health and they perceived all products as more natural. Those that believe that artificial colors and flavors are harmful for health perceived products to be less natural. Participants that stated that they try to eat foods that do not contain additives perceived products to be more natural. There were no significant differences, however, for the identified and unidentified Yogurt. Respondents that stated that they would like to eat only organically
grown vegetables, that they look for only Non-GMO ingredients in the foods they eat, and that they always look for natural ingredients in the snack foods that they eat perceived all statements to be more natural. There was no significant difference for the identified Yogurt for participants who look for natural ingredients in snack foods.

**United Kingdom**

The identified Strawberry Puree (Natural Color, Natural Flavor) and the identified Blueberry Yogurt (Natural Color, Artificial Flavor) were perceived to be natural by the largest percentage of UK respondents. The former was rated natural by 43% of respondents and the latter by 42% of respondents (Figure 3-1). There was no significant difference between these two and the unidentified Strawberry Puree, which was perceived as natural by 40% of respondents. The unidentified puree was also not significantly different from the unidentified Blueberry Yogurt statement (35% natural). There were no significant differences in naturalness perceptions for the unidentified Flamin’ Hot Cheetos® (Artificial Color, Natural Flavor), unidentified Gummy Candy (Artificial Color, Artificial Flavor), and the identified Cheetos, which were considered natural by 21%, 19%, and 18% of participants, respectively. There was also no significant difference between the identified Cheetos and the identified Gummy Candy (17% natural).

In general, males gave higher naturalness ratings than females. These differences were not significant, however, for the unidentified and identified Puree and the unidentified Yogurt. Millennials perceived the products to be more natural, but there were no significant differences for the identified Puree and identified Yogurt. Respondents with more education and more income perceived the products to be more natural than other groups in these demographics.
There were no significant differences for the unidentified Puree for income and for the identified and unidentified Yogurt and the identified Puree for both demographics. Generally, parents perceived products to be more natural than participants without kids, but there were no significant differences for the identified and unidentified Puree and the identified and unidentified Yogurt. These four statements had the least amount of significant differences for all of these demographics. Race was not a good predictor of perceptions of naturalness.

UK respondents who read ingredient statements more frequently when making purchases perceived all products to be more natural. Similarly, respondents who pay attention to the source of color and flavor more often were more likely to perceive the products as more natural. There were no significant difference, however, for the identified and unidentified Yogurt and the identified Puree for attention to source of color. Both of these products contain natural colors.

Respondents who reported that the source of color was important to them had higher perceptions of naturalness, though there were no significant differences for the identified Cheetos (which contain artificial colors) and the identified and unidentified Yogurt. For flavor source, the identified gummy candy (which contains artificial flavors) was the only product with significant differences and perceptions of naturalness were higher for respondents who report flavor source as important. Thirty-three percent and 44% of UK respondents stated that they were likely not to purchase products with artificial colors or artificial flavors, respectively. Those who were more likely not to purchase artificially colored or flavored products, however, perceived most products as more natural. There were no significant differences for the unidentified Puree for color and for the identified and unidentified Yogurt for color and flavor.

None of the products had significant differences in naturalness perceptions based on consumption of the commonly colored foods used in the survey. Generally, UK respondents that
frequently ate commonly colored/flavored foods perceived the statements to be more natural.

The identified Yogurt had the fewest significant differences. There were no significant difference for consumption of Cereal and Soda for the unidentified Puree; Cookies and Cereal for the unidentified Cheetos; Cereal, Fruit Juice, and Soda for the unidentified Gummy Candy; Cookies, Cereal, and Soda for the unidentified Yogurt; Cereal for the identified Puree; Cookies, Cereal, Fruit Juice, and Soda for the identified Cheetos; Cereal and Fruit Juice for the identified Gummy Candy; Cookies, Cereal, and Soda for the identified Cheetos; Cereal and Fruit Juice for the identified Gummy Candy; and Hard Candy, Gum, Breath Mints, Cereal, Fruit Juice, Soda, Energy Drinks, and Sports Drinks for the identified Yogurt. Breakfast Cereal, Soda, and Fruit Juice were poor predictors of naturalness perceptions for UK respondents. Those who agree that they are very particular about the healthiness of food perceived the unidentified and identified Puree and the identified Cheetos to be more natural. Twenty-three percent of UK respondents believe that artificially colored and artificially flavored foods are not harmful for health. These people perceived all of the products to be more natural than those who believe that artificially colored and flavored foods are harmful for health. Participants who state that they try to eat foods that do not contain additives perceived the products to be more natural, but there were no significant differences for the unidentified and identified Puree, and the identified Yogurt. Participants who would like to eat only organically grown vegetables perceived all of the products to be more natural. Those who look for only Non-GMO ingredients also perceived the products to be more natural. There were no significant differences for the unidentified and identified Puree and the identified Yogurt. Finally, participants who always look for natural ingredients in snack foods perceived the products to be more natural, though there was no significant difference for the unidentified Puree, unidentified Cheetos, and the identified Yogurt.
The fruit based products were perceived to be the most natural and there were no significant differences between the identified and unidentified. The identified Blueberry Yogurt (Natural Color, Artificial Flavor) was perceived as natural by 47% of Australian respondents and the identified Strawberry Puree (Natural Color, Natural Flavor) was perceived as natural by 43% of respondents (Figure 3-1). When unidentified, both the Yogurt and Puree were perceived to be natural by 41% of respondents. There was no significant difference between the unidentified Flamin’ Hot Cheetos® (Artificial Color, Natural Flavor) and the unidentified Gummy Candy (Artificial Color, Artificial Flavor), perceived natural by 25% and 19% of respondents, respectively. There was also no significant difference between the unidentified Gummy Candy and the identified Cheetos (20% natural) and the identified Gummy Candy (19% natural).

Males perceived the products to be more natural and females perceived the products to be less natural, but the difference was not significant for the unidentified Puree and the identified Yogurt. Millennials and Centennials perceived products to be more natural than respondents in the other generational groups. These differences were not significant for the identified and unidentified Puree and the identified Yogurt. There were only significant Race/Ethnicity differences for the identified and unidentified Cheetos and the identified and unidentified Gummy Candy statements. White/Caucasian respondents perceived these products to be less natural than other groups in this demographic. Respondents with more education perceived the products to be more natural, though there were no significant differences for the identified Puree and Yogurt statements. Income was not a good predictor of naturalness. There were only significant differences for the identified and unidentified Cheetos and the unidentified Gummy
Candy and respondents in the middle-income brackets perceived these statements to be more natural. There were no significant differences for any products based on number of children. There were no significant differences for frequency of reading ingredient statements for any of the products. Similarly, the identified Gummy Candy was the only product with a significant difference for attention to the source of color. Though this product contains artificial color, participants who pay attention to color source most of the time perceived this product to be more natural. Australian respondents who pay attention to the source of flavor more frequently perceived the products to be more natural. There were no significant differences for the identified Puree and the identified and unidentified Yogurt (which contains artificial flavor). There were no significant differences for any of the products based on the importance of the source of color or the source of flavor. Additionally, there were no significant differences for any of the products based on the likelihood not to purchase artificially colored or artificially flavored products.

In general, Australian participants who eat commonly colored foods more frequently, perceived the products to be more natural. There were no significant differences for Ice Cream, Gum, Cereal, Yogurt, Fruit Juice, and Soda for the unidentified Puree; Mints, Cereal, Juice, and Soda for the unidentified Cheetos; Cereal, Dressing, Yogurt, and Soda for unidentified Gummy Candy; Hard Candy, Ice Cream, Gum, Cereal, Dressing, Yogurt, Juice, and Soda for unidentified Yogurt; Soda for the identified Puree; Cereal and Soda for the identified Cheetos; Cereal and Yogurt for the identified Gummy Candy; and Hard Candy, Popsicles, Gum, Juice, Soda, and Sports Drinks for the identified Yogurt. Breakfast Cereal, Yogurt, Fruit Juice, and Soda consumption were poor predictors of naturalness ratings for Australian participants. Those that state that they are particular about the healthiness of food perceived the products to be more
natural, but there were no significant differences for the identified Puree and identified Gummy Candy. Twenty-one percent of Australian respondents believe that artificially colored and artificially flavored foods are not harmful for health. These people perceived all of the statements to be natural. There were no significant differences for the statement “I try to eat foods that do not contain additives”. Participants who would like to eat only organically grown vegetables perceived the unidentified Puree and unidentified Cheetos to be more natural. Those who look for only Non-GMO ingredients perceived the identified Cheetos to be more natural. Australian respondents who always look for natural ingredients in snacks perceived the unidentified Puree to be more natural than those who do not.

**Cross Country Comparisons**

Respondents from the US gave the highest mean naturalness scores for all products but the unidentified Strawberry Puree. Of the three regions, US respondents gave the lowest mean score to this product, though the difference was not significant. Overall, there was a significant difference by region, with the US scoring significantly higher on average than respondents from the UK and Australia. There was no significant difference between the latter two. Of the products, the identified Puree and Yogurt received higher mean naturalness scores than the unidentified for all three regions. Conversely, the identified Cheetos and Gummy Candy received lower mean naturalness scores than the unidentified. There were two distinct groupings, with the identified and unidentified Puree and Yogurt being significantly different from the identified and unidentified Cheetos and Gummy Candy. The US and Australia gave higher mean scores to the identified Yogurt and the UK gave about the same mean score to the Puree and Yogurt. In the grouping with the lower mean scores, the US and Australia gave higher mean scores to the
unidentified Cheetos statement and the UK gave higher mean scores to the unidentified Gummy Candy statement. All three regions gave the lowest mean naturalness scores to the identified Gummy Candy.

When considering demographics, there were not large differences between the US, UK, and Australia. It appears that Males, Millennials, and consumers with more education and higher income are the most likely to give higher naturalness scores that others in their respective demographic groups. This trend was seen in all three regions with the exception of income not being a good predictor of naturalness scores in Australia. Race/Ethnicity was a poor predictor of natural perceptions in all three regions. Additionally, it appears that frequent consumptions of some commonly colored foods and beverages may be good predictors of natural perceptions, but more so for Americans.

Australian respondents made the most selections and Americans made the least amount of selections when choosing which sources are appropriate sources of colors in foods and beverages. Respondents from all three regions associated Fruit, Fruit Juice, Vegetables, and Flowers with acceptable sources of food colors. Algae, Beans, Minerals, Roots, Food Dyes, and Bark were also associated with acceptable sources of food colors, though they were chosen by less than 50% of respondents from each country. Sea Weed was selected by all three regions, but was more associated with UK and Australian respondents. Americans strongly associated Extracts with being acceptable color sources. They were also more associated with Vitamins as a color source. Less than 25% of US respondents selected insects as being an acceptable source of food color. UK respondents, on the other hand, strongly associated insects with being an acceptable color source. They were less likely, however, to select Grains. Australian respondents associated Leaves as being an acceptable color source. Chemicals, Meat, Vitamins, Animal Skins.
or Bones, Clay, and Beneficial Microorganisms were selected by less than 25% of respondents from all three regions, with Beneficial Microorganisms being the least selected option.

Australian respondents also made the most selections for appropriate sources of flavor in foods and beverages and Americans made the least amount of selections. All three regions strongly associated Fruit, Fruit Juice, and Vegetables with being appropriate sources of food flavors. They also associated Algae, Meat, Flowers, Beans, Extracts, Minerals, Roots, Grains, Sea Weed, and Leaves with being acceptable. Respondents from the UK and Australia selected Flowers and Sea Weed more frequently than American respondents. Americans were more associated with Extracts and Vitamins and UK respondents were more associated Insects as acceptable flavor sources. Australians were more associated with Beans, Leaves, Clay, and Beneficial Microorganisms. Insects, Chemicals, Food Dyes, Clay, and Beneficial Microorganisms were selected by less than 25% of respondents from all three regions with Clay and Chemicals being the least selected options. Animal Skins and Bones were also selected by less than 25% of Americans, Bark was selected by less than 25% of UK respondents, and Vitamins were selected by less than 25% of UK and Australian respondents.
Table 3-3. ANOVA results of US, UK, and Australian participants’ naturalness scores to identified and unidentified products with various combinations of artificial and natural colors and flavors.

<table>
<thead>
<tr>
<th>Statement * Country</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blueberry Yogurt (Nat color, Art flavor)*US</td>
<td>5.55 a</td>
</tr>
<tr>
<td>Blind Yogurt (Nat color, Art flavor)*US</td>
<td>5.32 ab</td>
</tr>
<tr>
<td>Blueberry yogurt (Nat color, Art flavor)*AUS</td>
<td>5.21 abc</td>
</tr>
<tr>
<td>Strawberry Puree (Nat color, Nat flavor)*US</td>
<td>5.19 bcd</td>
</tr>
<tr>
<td>Strawberry Puree (Nat color, Nat flavor)*AUS</td>
<td>5.06 bcde</td>
</tr>
<tr>
<td>Strawberry Puree (Nat color, Nat flavor)*UK</td>
<td>5.04 bcde</td>
</tr>
<tr>
<td>Blueberry Yogurt (Nat color, Art flavor) *UK</td>
<td>5.03 bcde</td>
</tr>
<tr>
<td>Blind Puree (Nat color, Nat flavor) *AUS</td>
<td>4.97 bcde</td>
</tr>
<tr>
<td>Blind Yogurt (Nat color, Art flavor) *AUS</td>
<td>4.94 cde</td>
</tr>
<tr>
<td>Blind Puree (Nat color, Nat flavor) *UK</td>
<td>4.92 cde</td>
</tr>
<tr>
<td>Blind Puree (Nat color, Nat flavor) *US</td>
<td>4.84 de</td>
</tr>
<tr>
<td>Blind Yogurt (Nat color, Art flavor) *UK</td>
<td>4.75 e</td>
</tr>
<tr>
<td>Blind Cheetos (Art color, Nat flavor) *US</td>
<td>4.31 f</td>
</tr>
<tr>
<td>Blind Candy (Art color, Art flavor) *US</td>
<td>4.06 fg</td>
</tr>
<tr>
<td>Blind Candy (Art color, Art flavor) *UK</td>
<td>3.98 fgh</td>
</tr>
<tr>
<td>Blind Cheetos (Art color, Nat flavor) *AUS</td>
<td>3.98 fgh</td>
</tr>
<tr>
<td>Flamin’ Hot Cheetos (Art color, Nat flavor)*US</td>
<td>3.98 fgh</td>
</tr>
<tr>
<td>Blind Cheetos (Art color, Nat flavor) *UK</td>
<td>3.94 gh</td>
</tr>
<tr>
<td>Gummy Candy (Art color, Art flavor)*US</td>
<td>3.91 gh</td>
</tr>
<tr>
<td>Blind Candy (Art color, Art flavor) *AUS</td>
<td>3.86 ghi</td>
</tr>
<tr>
<td>Flamin’ Hot Cheetos (Art color, Nat flavor)*UK</td>
<td>3.74 ghi</td>
</tr>
<tr>
<td>Flamin’ Hot Cheetos (Art color, Nat flavor)*AUS</td>
<td>3.68 hi</td>
</tr>
<tr>
<td>Gummy Candy (Art color, Art flavor)*UK</td>
<td>3.65 hi</td>
</tr>
<tr>
<td>Gummy Candy (Art color, Art flavor)*AUS</td>
<td>3.53 i</td>
</tr>
<tr>
<td>Pr &gt; F(Model)</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>Significant</td>
<td>Yes</td>
</tr>
</tbody>
</table>

* Different letters denote a significant difference at p≤0.05
Table 3-4. Percentages of US, UK, and AUS respondents rating various color sources as acceptable for natural foods and beverages.

<table>
<thead>
<tr>
<th>Color Sources</th>
<th>US</th>
<th>UK</th>
<th>AUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit Juice</td>
<td>64%</td>
<td>63%</td>
<td>66%</td>
</tr>
<tr>
<td>Fruit</td>
<td>76%</td>
<td>78%</td>
<td>80%</td>
</tr>
<tr>
<td>Insects</td>
<td>17%</td>
<td>35%</td>
<td>26%</td>
</tr>
<tr>
<td>Chemicals</td>
<td>20%</td>
<td>22%</td>
<td>23%</td>
</tr>
<tr>
<td>Algae</td>
<td>33%</td>
<td>34%</td>
<td>35%</td>
</tr>
<tr>
<td>Vegetables</td>
<td>70%</td>
<td>75%</td>
<td>79%</td>
</tr>
<tr>
<td>Meat</td>
<td>23%</td>
<td>22%</td>
<td>25%</td>
</tr>
<tr>
<td>Flowers</td>
<td>52%</td>
<td>60%</td>
<td>64%</td>
</tr>
<tr>
<td>Beans</td>
<td>38%</td>
<td>35%</td>
<td>38%</td>
</tr>
<tr>
<td>Extracts</td>
<td>52%</td>
<td>49%</td>
<td>50%</td>
</tr>
<tr>
<td>Vitamins</td>
<td>23%</td>
<td>17%</td>
<td>19%</td>
</tr>
<tr>
<td>Minerals</td>
<td>30%</td>
<td>29%</td>
<td>32%</td>
</tr>
<tr>
<td>Animal Skins or Bones</td>
<td>12%</td>
<td>13%</td>
<td>15%</td>
</tr>
<tr>
<td>Roots</td>
<td>44%</td>
<td>46%</td>
<td>49%</td>
</tr>
<tr>
<td>Food Dyes</td>
<td>36%</td>
<td>42%</td>
<td>45%</td>
</tr>
<tr>
<td>Grains</td>
<td>26%</td>
<td>21%</td>
<td>27%</td>
</tr>
<tr>
<td>Clay</td>
<td>14%</td>
<td>16%</td>
<td>18%</td>
</tr>
<tr>
<td>Sea Weed</td>
<td>41%</td>
<td>52%</td>
<td>56%</td>
</tr>
<tr>
<td>Beneficial Microorganisms</td>
<td>10%</td>
<td>11%</td>
<td>11%</td>
</tr>
<tr>
<td>Leaves</td>
<td>42%</td>
<td>47%</td>
<td>55%</td>
</tr>
<tr>
<td>Bark</td>
<td>26%</td>
<td>26%</td>
<td>28%</td>
</tr>
</tbody>
</table>

Table 3-5. Percentages of US, UK, and AUS respondents rating various flavor sources as acceptable for natural foods and beverages.

<table>
<thead>
<tr>
<th>Flavor Sources</th>
<th>US</th>
<th>UK</th>
<th>AUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit Juice</td>
<td>68%</td>
<td>65%</td>
<td>68%</td>
</tr>
<tr>
<td>Fruit</td>
<td>80%</td>
<td>79%</td>
<td>81%</td>
</tr>
<tr>
<td>Insects</td>
<td>17%</td>
<td>24%</td>
<td>23%</td>
</tr>
<tr>
<td>Chemicals</td>
<td>9%</td>
<td>9%</td>
<td>11%</td>
</tr>
<tr>
<td>Algae</td>
<td>29%</td>
<td>32%</td>
<td>33%</td>
</tr>
<tr>
<td>Vegetables</td>
<td>73%</td>
<td>76%</td>
<td>81%</td>
</tr>
<tr>
<td>Meat</td>
<td>42%</td>
<td>42%</td>
<td>49%</td>
</tr>
<tr>
<td>Flowers</td>
<td>45%</td>
<td>50%</td>
<td>57%</td>
</tr>
<tr>
<td>Beans</td>
<td>49%</td>
<td>49%</td>
<td>54%</td>
</tr>
<tr>
<td>Extracts</td>
<td>46%</td>
<td>42%</td>
<td>43%</td>
</tr>
<tr>
<td>Vitamins</td>
<td>26%</td>
<td>21%</td>
<td>20%</td>
</tr>
<tr>
<td>Minerals</td>
<td>31%</td>
<td>32%</td>
<td>33%</td>
</tr>
<tr>
<td>Animal Skins or Bones</td>
<td>21%</td>
<td>25%</td>
<td>27%</td>
</tr>
<tr>
<td>Roots</td>
<td>49%</td>
<td>48%</td>
<td>56%</td>
</tr>
<tr>
<td>Food Dyes</td>
<td>11%</td>
<td>13%</td>
<td>14%</td>
</tr>
<tr>
<td>Grains</td>
<td>46%</td>
<td>39%</td>
<td>46%</td>
</tr>
<tr>
<td>Clay</td>
<td>9%</td>
<td>11%</td>
<td>12%</td>
</tr>
<tr>
<td>Sea Weed</td>
<td>42%</td>
<td>55%</td>
<td>59%</td>
</tr>
<tr>
<td>Beneficial Microorganisms</td>
<td>10%</td>
<td>14%</td>
<td>15%</td>
</tr>
<tr>
<td>Leaves</td>
<td>41%</td>
<td>45%</td>
<td>54%</td>
</tr>
<tr>
<td>Bark</td>
<td>26%</td>
<td>25%</td>
<td>28%</td>
</tr>
</tbody>
</table>
Figure 3-1. Percentage of US, UK, and AUS respondents who rated products represented by ingredient statements with natural or artificial colors or flavors as natural or unnatural.
General Discussion

Respondents from all three regions perceived the Strawberry Puree (Natural Color, Natural Flavor) and the Blueberry Yogurt (Natural Color, Artificial Flavor) to be more natural than the Flamin’ Hot Cheetos® (Artificial Color, Natural Flavor) and the Gummy Candy (Artificial Color, Artificial Flavor). Both statements, in addition to having plant based ingredients (Strawberry Puree Concentrate, Blueberries, Fruit and Vegetable Juice), are shorter ingredient statements. Both contain about 15 ingredients, which is much shorter than the Cheetos statement that contains over 20. Of the four statements, the Gummy Candy is the shortest. This somewhat supports the conclusions made in Chapter 2, that shorter ingredient statements are perceived to be more natural than longer ingredient statements, like the Cheetos. It adds an additional element, which suggests that consumers look at statement length and ingredients to make decisions about naturalness. Though the gummy candy statement was the shortest, it contains artificial colors, artificial flavors, and ingredients with chemical sounding names. This combination outweighed the length of the statement and the product was perceived to be less natural. Comparing the naturalness scores of Cheetos and Yogurt, it may be possible that artificial flavors are more acceptable additives than artificial colors. Artificial colors are commonly associated with health conditions like ADD and ADHD, so it may be this negative association that gives greater weight to colorants on perceptions of naturalness. It may also be because artificial colorants are more clearly listed on ingredient statements, whereas flavors are simply listed as “artificial flavors”. A chain of multiple artificial colors (such as Yellow 5, Red 40, Yellow 6, Blue 1, from the Gummy Candy statement) is more visible and therefore more influential.
The Cheetos and Gummy Candy statements were perceived to be significantly less natural by participants from all three regions. Their ingredient statements contain artificial colors, which are clearly stated using their chemical names (Red 40, for example). Including the identity of the statement appears to have an impact on perceptions of naturalness. Adding the product identity increased naturalness scores for the Puree and Yogurt and decreased naturalness scores for the Cheetos and the Gummy Candy. This may indicate that the product as a whole is primarily how consumers make judgements about product naturalness. Secondary to this is the individual parts, or ingredients, that make up the whole. The Strawberry Puree, for example, contains ingredients like Monocalcium Phosphate, Sodium Alginate, and Methylcellulose.

Chambers et al. found that consumer perceived ingredients with chemical sounding names to be less natural than ingredients with common names (Sodium Bicarbonate vs. Baking Soda, for example) (Chambers, 2018). Though participants could see these chemical sounding ingredients in the Puree statement, the name Strawberry Puree increased their perceptions of naturalness. When unidentified, respondents from the UK and Australia gave slightly higher scores to the Puree, the statement with Natural Colors and Natural Flavors. Americans, on the other hand, still perceived the yogurt to be more natural than the Puree. This indicates that ingredients in the statement affect perceptions and it is more than just the color and flavor additives that consumers use as clues of product naturalness. This supports Evans’ conclusion that food content is important in perceptions of product naturalness (Evans, 2010). In addition to containing artificial colors (and artificial flavors in the Gummy Candy), the Cheetos and Candy statements contain chemical sounding ingredients or ingredients that may be novel to consumers. This could be explain why these statements, even when unidentified, received significantly lower naturalness scores. When identified, the scores dropped even lower. Chambers also found that novelty of
ingredients also affects perceptions of naturalness, as sorghum flour was rated as less natural than wheat flour (Chambers, 2018).

The Cheetos and Gummy Candy are also likely associated with more processing. Rozin discovered that highly processed products were perceived as less natural than products with less processing (Rozin, 2006). Strawberry Puree mostly involves physical processing, which was found by Rozin to be more natural to consumers than chemical processing (Rozin, 2005).

Blueberry Yogurt is produced through fermentation, which consumers may see as being more natural than extrusion or gel formation. An additional explanation for the drop in score when the Cheetos and Gummy Candy were identified could be related to health. Compared to Strawberry Puree and Blueberry Yogurt, Cheetos and Gummy Candy are not healthy products. Dominick found that 63% of their survey participants associated natural foods with “Improved nutritional value” (Dominick, 2018). A snack product and candy product are not commonly associated with being nutritious foods and it may be because of this that they received lower naturalness scores once identified. Forty-eight percent of American respondents, 45% of UK respondents, and 57% of Australian respondents disagreed with the statements “In my opinion, artificially colored/flavored foods are not harmful for my health”. There is still a large group of consumers that is concerned about color and flavor additives in foods and beverages. This likely influenced naturalness scores for the two statements that contain four artificial colors each along with artificial flavors in the Candy. Respondents that agreed with the statement were more likely to perceive all of the products as natural.

Thoughts about appropriate sources of natural colors and flavors were similar between the US, UK, and Australia. Of the three countries, Australians made more selections for both color and flavor sources and Americans made the least. This could mean that Americans are
more particular about colorants and flavorants or that Australians are more open minded about natural additive sources. It could also mean that Americans are less willing to participate in Check All That Apply questions. Respondents believe that plant derived additives are much more appropriate than animal, insect, or microbial derived additives or additives than come from the earth, like minerals. The most selected color and flavor sources include Fruit, Fruit Juice, Vegetables, and Flowers. These results mostly align with the FDA’s definition of natural flavor (CFR, 2018). The largest discrepancy was that participants from the UK associated insects as being an appropriate source of color much more frequently than Americans and Australians. This could indicate that respondents from the UK are less prone to neophobia and are more accepting of the use of insects as ingredients in foods and beverages.

**Limitations**

There were some limitations with this study. Only four ingredient statements were used to measure perceptions of naturalness. In addition, all of the products used were food products. More research could be done using more products and beverages to verify the results of the present study. Only three English-speaking countries participated in the online survey. Further research is needed to understand the naturalness perceptions of consumers from Latin America, Africa, Asia, and other European countries.

**Conclusion**

The results from this experiment illustrate that there are many cues that consumers use when determining the naturalness of a food or beverage. Possibly the most important factor is the product as a whole. When statements were identified, naturalness ratings for the Strawberry
Puree and Blueberry yogurt increase whereas naturalness ratings for the Flamin’ Hot Cheetos® and Gummy Candy decreased. The presence of artificial colors and artificial flavors appears to have an impact on naturalness perceptions, but other ingredients or additives also influence perceptions. Between artificial colors and flavors, the former may influence naturalness perceptions more so than flavors. This could possibly be due negative health associations with artificial colors or the manner in which they are listed on ingredient statements. In addition to colorants and flavorants affecting perceptions of naturalness, ingredients with chemical sounding names and novel ingredients also influence consumers. Along with content, process also has and affect. The two more processed products, Cheetos and Gummy Candy, were perceived to be less natural than the less processed products. Finally, the perceived healthiness of a product likely impacts consumers beliefs about naturalness as the less healthy products were deemed less natural than the fruit based products. All of these factors combine to form the idea of naturalness in the mind of a consumer.

References


Chapter 4 - Naturalness Perceptions of Whole Foods and the Impact of the Ingredient Statement

Abstract

Natural food is a controversial topic in the United States due to the lack of a formal definition. The US, however, is not the only country that does not have firm rules about what constitutes a food as natural. Many researchers have looked to consumers to help define natural foods, but there has been a lack of research on how ingredient statements affect perceptions of naturalness. Work has been published on consumer perceptions of the naturalness of ingredients, but no work has been done to understand perceptions of whole foods with and without their corresponding ingredient statements. The objective of this study was to understand how consumers from three English-speaking countries perceived the naturalness of four non-processed food products when shown subcomponent statements with and without product identification. An online survey was launched in the United States, United Kingdom, and Australia, targeting 1000 consumers in each country. Results show that both product identity and ingredient/subcomponent statement influence perceptions of naturalness. However, the statement is more influential than product identity when the statement contains a high volume of unfamiliar ingredients with chemical sounding names. This research helps to form a more complete picture about the factors involved in consumer perceptions of naturalness.

Introduction

Food preference is an important for food producers, helping gain more understanding of how consumers make selections while shopping. With so many options in the grocery store,
consumers not only have to decide between competing brands and prices, but also have to decide if they want to purchase organic or “natural” foods. “Natural” foods, in particular, are of interest due to the lack of a formal definition. In the United States, the U.S. Department of Agriculture (USDA) and the Food and Drug Administration (FDA) are responsible for “Natural” label claims (Parasidis, 2015). The USDA is responsible for “Natural” claims on meat, poultry, and egg products and the FDA is responsible for “Natural” claims on all other foods and beverages (Parasidis, 2015). Both of these organizations do not have an official definition for the term, leading to confusion and uncertainty on the part of the consumer and frustration on the part of food producers. The USDA and FDA do, however, have guidelines for “Natural” foods. While the FDA decided not to define the term in the 1990’s, they do not restrict the use of the claim except on products with “added color, synthetic substances, and flavors” (Department of Health and Human Services, 2015). The USDA guidelines specify that foods with the “Natural” claim cannot contain artificial ingredients or added colors and must be minimally processed (FSIS, 2015). Other countries have similar organizations that may have different responsibilities and different rules regarding the “Natural” claim. The European Union does not have a definition for natural foods, but does have regulations about the use of “Natural” for flavor additives (European Parliament, 2008). The United Kingdom states that “Natural” foods must contain ingredients that come from nature and are not interfered with by humans. “Natural” foods must also not contain chemical additives or flavorings that are produced by a chemical industry or extracted by a chemical process (Food Standards Agency, 2008). Australia and New Zealand have similar guidelines for “Natural” foods. Williams states that these foods should not contain any additives or be “significantly altered” physically, chemically, or biologically (Williams, 2009).
With the lack of a formal definition, researchers have studied consumers and their internal definitions and perceptions of “Natural” foods to better understand these foods. In their review, Román et al. found that consumers think “Natural” foods should have no artificial colors, no additives, and no human intervention (Román, 2017). Similarly, Abrams and Meyers found that focus group participants consider food natural if it does not contain any additives, preservatives, hormones, or chemicals (Abrams, 2010). Dominick found that consumers associate the “Natural” food label with a lack of preservatives, hormones, and antibiotics. These consumers also associated the label claim with increased nutritional value and animal welfare and with safer food in general (Dominick, 2018). Additionally, consumers believe that physical changes to food are more acceptable than chemical changes, that both processing and content are important, and the presence of an E-number on a label is seen as less natural (Rozin, 2005; Rozin 2006; Evans 2010; Siegrist, 2017). Chambers et al. studied consumer perceptions of naturalness related to specific food ingredients. Of the 630 consumers included in their survey, no more than 69% of respondents rated the ingredients as natural. They confirmed that a chemical sounding name is perceived as less natural than a common name for food ingredients. They also found evidence that familiarity with ingredients and neophobia influence the naturalness perceptions of food ingredients (Chambers, 2018).

It is common to study consumer perceptions of whole (non-processed) food products or food ingredients. McMackin used focus groups to understand the perceptions of whole grains among consumers in the United Kingdom. They found that there are several barriers that prevent consumers from purchasing foods made with whole grains. In addition to a lack of knowledge about what whole grains are, their health properties, and how to cook with them, McMackin concluded that the largest barrier was related to negative perceptions of the sensory properties
Bus used a paper questionnaire to study Australian consumers’ perceptions of whole milk, reduced fat milk, and soymilk. Participants had similar perceptions about the body and bone-related benefits of the three beverages, but believe that whole milk is more likely to trigger allergies and disease and soymilk is better at preventing disease. They even conclude that there is some degree of “magical thinking” when it comes to perceptions about soymilk (Bus, 2003). Font-i-Furnols and Guerrero conducted a review of studies relating to perceptions and behaviors associated with meat. They examine consumer expectations of quality, beliefs about meat and meat production, visual perceptions relating to meat color and marbling, perceptions and preferences for mean texture, and perceptions of and preferences for meat flavor and aroma (Font-I-Furnols, 2014). Castro used an online survey to study consumer perceptions about insect-based ingredients in food products. Of the thirteen countries studied, only China, Thailand, Brazil, Peru, and Mexico had a greater percentage of consumers willing to try food products made with insect-based ingredients (Castro, 2018).

There has also been research conducted on perceptions of food and food labeling. Such research has studied the effect of product name and description on perception, the impact of label claims and ingredient claims on expectations liking, the effect of pictures and photographs on expectations and perceptions, and the impact of organic certification logos on preference and willingness to pay. Additionally, use of and beliefs about nutrition labels and how these labels affect expectations and sensory perceptions has been studied (Campos, 2011; Piqueras-Fiszman, 2015; Schouteten, 2015; Janssen, 2012).

Aside from Chambers’ work on consumer naturalness perceptions of food ingredients, no work has been done to study the naturalness perceptions of whole foods. Additionally, little work has been done to analyze the influence of ingredient statements on the perceptions of whole
foods. This study was conducted to address this gap in knowledge. The objectives of this study were (1) to understand consumer perceptions of naturalness related to whole foods when shown a blind subcomponent statement compared to when shown an subcomponent statement along with the product identity and (2) to compare differences in perceptions across various demographic among three English-speaking countries.

**Materials & Methods**

A standardized online questionnaire was used to gather data for this study in three countries: United States (US), United Kingdom (UK), and Australia (AUS).

**Questionnaire**

The survey was launched using Qualtrics Survey Software (Provo, UT, USA). Participants were compensated using a reward system offered by Qualtrics. Respondents were shown four subcomponent statements taken from whole foods. The foods used include a Peach, Cherries, a Banana, and a Chicken Egg. Each statement includes the macro and micronutrients that make up each food. The statements were transcribed from images found on the internet created by James Kennedy and were standardized so that they were all similar in format. Certain names were changed or expanded. Aqua, for example, was changed to water. The E-number of was used in the original images for many subcomponents, but was less specific for the food colors. Therefore, items such as E160a were expanded to Carotene E160a to match other items in the statements such as Fiber E460. The first two product statements shown to respondents were shown without the identity of the product and participants were asked to rate the naturalness of the food on a 9-point scale ranging from “1 – Not At All Natural” and “9 – Extremely Natural”. 
Following these questions, the identity of the food was revealed on a separate page of the survey without the corresponding subcomponent statement. Respondents were asked, “The ingredient statement on the previous page is an actual list for a fresh Peach/fresh Cherries. How natural do you think this food is now?”. For the next two products, the Banana and the Chicken Egg, participants were given the identity of the food along with the subcomponent statement and were asked to rate their perceived naturalness of the product. The questionnaire was formatted in this manner to understand how the name of a product affects consumer perceptions of food naturalness.

Participants were also asked various demographic questions including gender, age, race/ethnicity (using race demographics commonly used in each country/region), education level, income (using income brackets commonly used in each country/region), and number of children. They were asked how often they read ingredient statements, how often they pay attention to the source of coloring/flavoring on labels, importance of color/flavor on the label, and likelihood to purchase based on the presence of artificial colors and artificial flavors in food. Participants were shown a list of commonly colored foods and beverages and asked to rate the frequency in which they consume those foods. Finally, participants were shown various items from the Health and Taste Attitudes Scale to understand the relation between naturalness perceptions and other food based behaviors. The questionnaire can be found in the appendix.

Consumers

One thousand participants from the US, UK, and Australia were recruited. English speaking countries were chosen so that comparisons could be made across cultures that speak a common language with slight variations in spelling and wording. Gender, age, and estimate of household
grocery shopping were used to recruit participants. Participants were not included if they were under 18 years of age or did less than 40% of the grocery shopping for their household. Gender quotas were set to 50% males and 50% females. Age quotas were set to 20-25% for participants aged 18-23, 24-41, 42-52, and 53-73 and 10% or less for participants 74 years or older. Rather than using traditional age brackets, generational groups were used to understand differences in perception based on age. The generational groups, from youngest to oldest, were Centennials/Gen Z, Millennials/Gen Y, Gen X, Baby Boomers, and the Silent Generation.
Table 4-1. Demographic percentages*

<table>
<thead>
<tr>
<th>Demographic Characteristics</th>
<th>Categories</th>
<th>US</th>
<th>UK</th>
<th>AUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Male</td>
<td>48%</td>
<td>50%</td>
<td>48%</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>52%</td>
<td>50%</td>
<td>52%</td>
</tr>
<tr>
<td>Age</td>
<td>Centennials/Gen Z</td>
<td>25%</td>
<td>15%</td>
<td>14%</td>
</tr>
<tr>
<td></td>
<td>Millennials/Gen Y</td>
<td>18%</td>
<td>23%</td>
<td>24%</td>
</tr>
<tr>
<td></td>
<td>Gen X</td>
<td>26%</td>
<td>26%</td>
<td>26%</td>
</tr>
<tr>
<td></td>
<td>Baby Boomers</td>
<td>20%</td>
<td>26%</td>
<td>26%</td>
</tr>
<tr>
<td></td>
<td>Silent Generation</td>
<td>11%</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>Race/Ethnicity</td>
<td>American Indian/Alaska Native</td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Asian</td>
<td>4%</td>
<td>5%</td>
<td>12%</td>
</tr>
<tr>
<td></td>
<td>Black/African/Caribbean</td>
<td>10%</td>
<td>3%</td>
<td>1%</td>
</tr>
<tr>
<td></td>
<td>Hispanic/Latino</td>
<td>6%</td>
<td>0%</td>
<td>1%</td>
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<tr>
<td></td>
<td>Caucasian/White</td>
<td>77%</td>
<td>90%</td>
<td>82%</td>
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<td></td>
<td>Aboriginal/Torres Strait</td>
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<td>1%</td>
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<tr>
<td></td>
<td>Other</td>
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<td>&lt;1%</td>
<td>1%</td>
</tr>
<tr>
<td></td>
<td>Prefer Not to Answer</td>
<td>1%</td>
<td>2%</td>
<td>1%</td>
</tr>
<tr>
<td>Education</td>
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<td>34%</td>
<td>33%</td>
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<tr>
<td></td>
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<td>18%</td>
<td>25%</td>
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<tr>
<td></td>
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<td>33%</td>
<td>27%</td>
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<tr>
<td></td>
<td>Post Graduate</td>
<td>16%</td>
<td>13%</td>
<td>15%</td>
</tr>
<tr>
<td></td>
<td>Prefer Not to Answer</td>
<td>1%</td>
<td>2%</td>
<td>1%</td>
</tr>
<tr>
<td>Number of Children</td>
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<td>64%</td>
<td>63%</td>
</tr>
<tr>
<td></td>
<td>One Child</td>
<td>14%</td>
<td>16%</td>
<td>16%</td>
</tr>
<tr>
<td></td>
<td>Two Children</td>
<td>16%</td>
<td>14%</td>
<td>15%</td>
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<tr>
<td></td>
<td>Three Children</td>
<td>3%</td>
<td>5%</td>
<td>4%</td>
</tr>
<tr>
<td></td>
<td>Four or More Children</td>
<td>2%</td>
<td>1%</td>
<td>2%</td>
</tr>
</tbody>
</table>

* Percentages were based on 932, 959, and 969 respondents from the US, UK, and AUS, respectively.
Excel (Microsoft Office Pro ver. 2013) was used to calculate means and percentages, for descriptive statistics, and for chi-square tests for significance (p-values less than 5% were considered significant). XLSTAT (Addinsoft, New York, NY, USA) was used for Analysis of Variance. Prior to analysis, the 9-point naturalness scales were converted to 3-point scales to understand larger trends in perceptions. The reduced scale was converted to 1-Unnatural, Neither natural no unnatural, and 3-Natural. Respondents with incomplete surveys were removed from

<table>
<thead>
<tr>
<th>Demographic Characteristics</th>
<th>Categories</th>
<th>US</th>
<th>UK</th>
<th>AUS</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Less than $52,000</td>
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<td></td>
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</tr>
<tr>
<td></td>
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<td>17%</td>
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<td></td>
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<td>12%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$208-259,999</td>
<td>10%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>$260,000 or more</td>
<td>6%</td>
<td></td>
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<td>33%</td>
<td></td>
</tr>
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<td>£20,000 - £39,999</td>
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<td>£40,000 - £59,999</td>
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<td>16%</td>
<td></td>
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<td></td>
<td>£60,000 - £79,999</td>
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<td>5%</td>
<td></td>
</tr>
<tr>
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<td>39%</td>
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<td>1%</td>
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<td>$260,000 or more</td>
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<td>1%</td>
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<td>Prefer Not to Answer</td>
<td></td>
<td></td>
<td>3%</td>
</tr>
</tbody>
</table>

* Percentages were based on 932, 959, and 969 respondents from the US, UK, and AUS, respectively.

**Analysis**

Excel (Microsoft Office Pro ver. 2013) was used to calculate means and percentages, for descriptive statistics, and for chi-square tests for significance (p-values less than 5% were considered significant). XLSTAT (Addinsoft, New York, NY, USA) was used for Analysis of Variance. Prior to analysis, the 9-point naturalness scales were converted to 3-point scales to understand larger trends in perceptions. The reduced scale was converted to 1-Unnatural, Neither natural no unnatural, and 3-Natural. Respondents with incomplete surveys were removed from
the analysis. It has been found that some survey respondents are inattentive and may answer
questions without thinking or may check boxes without fully reading the questions (Baker and
Le Guin, 2007; Allen, 1996). A fake or “cheater” question was included in the survey to identify
these respondents (Yang et al., 2015). Participants who reported consuming ‘Live worms’ or
‘Pickled chicken’ in the past week were excluded from the survey. After exclusion, 932
respondents from the US, 959 from the UK, and 969 from Australia were included in the
analysis.

Results & Discussion

United States

American naturalness perceptions varied based on the food presented and the presence of
product identity. The first product shown to the respondents, the unidentified Peach, received the
lowest mean naturalness score. This product significantly differed from all other products and
was perceived natural by 22% of respondents (Figure 4-1). When identified, the average
naturalness score raised significantly and was perceived to be natural by 75% of American
respondents. There was also a significant difference between the unidentified and identified
Cherries. The identified Cherries received the highest average naturalness score and were
perceived to be natural by 77% of American respondents versus 41% when unidentified. There
was no significant difference between the Chicken Egg and the Banana, which were considered
natural by 40% and 37% of respondents, respectively. The former was also not significantly
different from the unidentified Cherries.

For the American respondents, there were no significant differences in naturalness
perceptions for the identified Peach, identified Cherries, Banana, and Chicken Egg for any of the
demographics. Males perceived the unidentified Peach and unidentified Cherries to be more natural and females perceived the unidentified Peach and unidentified Cherries to be less natural. Younger participants, specifically the Millennials, perceived these products to be more natural, and older generations perceived these products as less natural. Participants with more education, higher incomes, and with children perceived the unidentified Peach and Cherries as more natural than others in their respective demographic groups. American respondents who read ingredient statements more often and who pay attention to the source of color and flavor on statements more often perceived these products as more natural. Additionally, respondents who reported that the source of color and source of flavor in foods is important and respondents who are likely not to purchase a food if it contains artificial colors or artificial flavors also perceived these products as more natural. Race/ethnicity was not a good predictor of naturalness perceptions.

American respondents who frequently consume commonly colored foods perceived the unidentified Peach and Cherries to be more natural. There were no significant differences, however, for Juice consumption for both products, and for Dressing and Soda consumption for the Cherries. Respondents who agreed that they are particular about the healthiness of foods and that artificially colored and artificially flavored foods are not harmful for health also perceived the unidentified Peach and Cherries to be more natural. Similarly, respondents who look for only Non-GMO ingredients in the foods they eat and always look for natural ingredients in snack foods perceived both of these products to be more natural. Americans that try to eat foods that do not contain additives and who would like to eat only organically grown vegetables perceived only the unidentified Peach to be more natural.

1971

1972
United Kingdom

As with the Americans, the unidentified Peach was perceived to be the least natural. It was considered natural by 15% of UK respondents and significantly differed from all other products (Figure 4-1). When identified, the score rose significantly as was perceived to be natural by 78% of respondents. The identified Cherries received the highest mean naturalness score and were perceived to be natural by 82% of UK respondents. The unidentified Cherries (31% natural) were significantly different from the identified Cherries, but did not differ significantly from the Chicken Egg, which was considered natural by 39% of respondents. The unidentified cherries also did not differ significantly from the Banana, perceived as natural by 35% of respondents, though there was a significant difference in naturalness perceptions between the Banana and the Chicken Egg.

Similar to the Americans, there were little to no significant differences for the identified Peach, identified Cherries, Banana, and Chicken Egg. There were no significant differences among UK respondents by gender or by race/ethnicity. Additionally, number of children was a poor predictor of naturalness perceptions. Younger generations, specifically the Millennials, perceived the products to be more natural. Respondents with more education and higher incomes rated the products as more natural than others in their demographic groupings. Respondents who report reading ingredient statements more often perceived the unidentified Peach, unidentified Cherries, and the Banana to be more natural than those who read statements less frequently. Those who report paying attention to the source of color and flavor on ingredient statements perceived the unidentified Peach and Cherries to be more natural. Respondents who reported that the source of color in foods was important to them perceived the unidentified Peach to be more natural. UK respondents who state that they are likely not to purchase a food if it contains

95
artificial colors or artificial flavors perceived the unidentified Peach and Banana to be more
natural.

UK respondents who frequently consume commonly colored foods perceived the
unidentified Peach and unidentified Cherries as more natural. There were no significant
differences for Fruit Juice for the former and for Cookies, Breakfast Cereal, Fruit Juice, and Soda
for the latter. Respondents who frequently consume Flavored Gelatin and Sports Drinks
perceived the Banana to be more natural. Those who believe that artificial colored foods and
artificially flavored foods are not harmful for health, who try to eat foods that do not contain
additives, and who would like to eat only organically grown vegetables perceived the
unidentified Peach and Cherries as more natural. UK respondents who agree that they look for
only Non-GMO ingredients in the foods they eat perceived the unidentified Peach, unidentified
Cherries, and Banana as more natural. Respondents who agree that they always look for natural
ingredients in the snack foods they consume perceived the identified Peach as more natural.
There were no significant differences for any of the products based on the statement “I am
particular about the healthiness of food”.

Australia

Similar to the US and UK participants, Australian respondents perceived the unidentified
Peach to be the least natural product. It considered natural by 19% of the respondents and was
significantly different from all other products (Figure 4-1). The identified Peach scored
significantly higher and did not differ significantly from the identified Cherries. The former was
considered natural by 81% of respondents and the latter by 82%. When unidentified, the Cherries
scored significantly lower and were perceived natural by 35% of Australian respondents. There
was no significant difference between the unidentified Cherries and the Chicken Egg (37% natural) and no significant difference between the Chicken Egg and the Banana (33%), although the unidentified Cherries were significantly different from the Banana.

As with UK respondents, there were little to no significant differences for the identified Peach, identified Cherries, Banana, and Chicken Egg for the studied demographics. Males perceived the unidentified Peach and Cherries to be more natural and females perceived the unidentified Cherries to be less natural. Younger generations, specifically the Millennials, perceived the unidentified Peach, unidentified Cherries, and Chicken Egg to be more natural and older generations perceived the Chicken Egg to be less natural. Respondents with more education perceived the unidentified Peach and Cherries to be more natural. Those with higher income, who have children, and who pay attention to the source of flavor in foods perceived only the unidentified Peach to be more natural. Australian respondents who read ingredient statements more often perceived the unidentified Peach and Cherries to be more natural than those who read ingredient statements less frequently. Race and level of attention to the source of color in foods were poor predictors of naturalness perceptions for Australian respondents. Additionally, there were no significant differences for any of the products based on importance of color and flavor source in food and likelihood not to purchase a food with artificial colors or artificial flavors.

Australian respondents who frequently consume commonly colored foods perceived the unidentified Peach and unidentified Cherries as more natural. There were no significant differences for Cookies, Breakfast Cereal, and Soda for the unidentified Peach and for Breakfast Cereal, Fruit Juice, and Soda for the unidentified Cherries. Respondents who frequently consume Toaster Pastries, Flavored Gelatin, and Energy Drinks perceived the Banana as more natural and respondents who frequently consume Toaster Pastries, Popsicles, Flavored Gelatin, Yogurt, Fruit
Juice, and Sports Drinks perceived the Chicken Egg as more natural. Australians who believe artificially colored and artificially flavored foods are not harmful for health and who always look for natural ingredients in snack foods perceived the unidentified Peach and Cherries as more natural. Those who stated that they are particular about the healthiness of foods perceived only the unidentified Cherries as more natural. Those who agree that they try to eat foods that do not contain additives perceived the Banana as more natural than those who disagreed with this statement. Respondents who would like to eat only organically grown vegetables and who look for only Non-GMO ingredients in the foods they eat perceived only the Chicken Egg as more natural than other respondents.

Cross Country Comparison

There were no significant differences in mean naturalness scores between the US, UK, and Australia. All three countries scored the unidentified Peach as the least natural and these scores significantly differed from all of the other products tested. When identified, the scores increased significantly, with Australians giving slightly higher mean scores and Americans giving slightly lower mean scores. All three countries also rated the identified Cherries as the most natural. Generally, there was no significant difference in naturalness scores between the identified Cherries and the identified Peach although UK respondents gave a significantly higher score to the identified Cherries than US respondents gave to the identified Peach. The Cherries were given significantly lower naturalness scores when unidentified, with UK respondents rating them as significantly less natural than US respondents. There were no significant differences between the Chicken Egg scores and no significant differences between the Banana scores. The
US and UK respondents, however, gave the Chicken Egg significantly higher naturalness scores than the Australian respondents gave to the Banana.

### Table 4.3. US, UK, and Australian respondent perceptions of naturalness of four whole food products.

<table>
<thead>
<tr>
<th>Product*Country</th>
<th>Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cherries, Identified*UK</td>
<td>7.42&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Cherries, Identified*AUS</td>
<td>7.40&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td>Peach, Identified*AUS</td>
<td>7.27&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td>Peach, Identified*UK</td>
<td>7.17&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td>Cherries, Identified*US</td>
<td>7.16&lt;sup&gt;ab&lt;/sup&gt;</td>
</tr>
<tr>
<td>Peach, Identified*US</td>
<td>7.01&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Cherries, Blind*US</td>
<td>4.91&lt;sup&gt;c&lt;/sup&gt;</td>
</tr>
<tr>
<td>Cherries, Blind*AUS</td>
<td>4.64&lt;sup&gt;cd&lt;/sup&gt;</td>
</tr>
<tr>
<td>Chicken Egg*UK</td>
<td>4.62&lt;sup&gt;cd&lt;/sup&gt;</td>
</tr>
<tr>
<td>Chicken Egg*US</td>
<td>4.62&lt;sup&gt;cd&lt;/sup&gt;</td>
</tr>
<tr>
<td>Cherries, Blind*UK</td>
<td>4.44&lt;sup&gt;de&lt;/sup&gt;</td>
</tr>
<tr>
<td>Chicken Egg*AUS</td>
<td>4.40&lt;sup&gt;de&lt;/sup&gt;</td>
</tr>
<tr>
<td>Banana*US</td>
<td>4.33&lt;sup&gt;de&lt;/sup&gt;</td>
</tr>
<tr>
<td>Banana*UK</td>
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<td>4.13&lt;sup&gt;e&lt;/sup&gt;</td>
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<tr>
<td>Peach, Blind*AUS</td>
<td>3.25&lt;sup&gt;fg&lt;/sup&gt;</td>
</tr>
<tr>
<td>Peach, Blind*UK</td>
<td>3.03&lt;sup&gt;fg&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Pr > F(Model) < 0.0001
Significant: Yes

* Different letters denote a significant difference at p≤0.05
Figure 4-1. US, UK, and Australian respondent naturalness ratings of whole foods
General Discussion

Respondents from all three countries highly relied on product identity when rating a product as natural. The first product statement that was shown to respondents, the unidentified Peach, was deemed the least natural by all three countries. This subcomponent statement, as well as the statement of the other three products, contained subcomponents with long, chemical sounding names. While consumers may be familiar with more common components like Glucose or Sucrose, they are likely unfamiliar with the Fatty Acids and Amino Acids. Names like Octadecatrienoic Acid or Isoleucine may cause consumers to think more about chemistry and components that come from a lab, rather than naturally occurring substances. This confirms conclusions made by Chambers et al. They found that consumers rated ingredients with chemical names and ingredients they were less familiar with as unnatural (Chambers, 2018). The statements for the Peach, Cherries, Banana, and Chicken Egg contain both such components. Without knowing the identity of the product they were scoring, consumers perceived the unidentified Peach to be unnatural. After the Peach and Cherries were identified, naturalness scores increased significantly. This supports the conclusion made in Chapter 3 that the product as a whole has a large impact on perceptions of naturalness. The identified Peach and Cherries were the only products that received mean scores above a five on the naturalness scale. Although the product contained the same subcomponents, once consumers knew that these subcomponents were in a fresh Peach and fresh Cherries, their perceptions changed.

The identity of the Banana and Chicken Egg were never hidden from consumers in this survey. Both of these products were rated as significantly less natural than the Peach and Cherries, with mean naturalness scores less than five. Although these questions had a similar format, consumers were shown the ingredient statement and the product identity at the same time.
for the Banana and Chicken Egg, whereas the Peach and Cherries were identified on a following page without seeing the statement for a second time. This indicates that when the product identity and subcomponent statement are combined, the statement holds more weight. This adds to the results from Chapter 3, where it appeared that the product identity held more weight than the sum of its parts. However, the Banana and Chicken Egg statements differ from the statements presented in Chapter 3. The product statements in Chapter 3 follow typical labeling guidelines and therefore did not contain near as many ingredients with long, chemical sounding names as the statements in the current study. Exposure to a high volume of long chemical names may cause a shift in the minds of consumers, with more weight being put on the statement than the product identity when making judgements about naturalness. This shift appears to be somewhat universal since there were no significant differences between the US, UK, and Australia, and relatively few significant differences between the studied demographics. This also explains why product identity was more influential with the Peach and Cherries since consumers could no longer see the subcomponent statement when rescoring product naturalness. Siegrist found that inclusion of an E-number on an ingredient statement significantly decreased perceptions of naturalness (Siegrist, 2017). All four of the product statements contained E-numbers and these likely affected perceptions of naturalness. Less so for the identified Peach and Cherries, since consumers could no longer see them when rating naturalness. Another factor that likely influenced consumers is the length of the statements. All four products had long statements and when this was visible to consumers, as with the Banana and the Chicken Egg, it decreased perceptions of naturalness.
Limitations

There were some limitations to this study. The survey only included four whole food products, three of which were fruits. Additional research can be conducted using vegetables, meats, and grains or beverages like cow’s milk and fruit juice. Additionally, only three English-speaking countries were studied. More research is needed to validate these results with consumers in other regions like Latin America, Africa, Asia, and other European countries.

Conclusion

It is evident that consumers rely on a combination of cues to make decisions about the naturalness of a food or beverage product. Both product identity and ingredients/subcomponents that make up the product are two of these cues that consumers look to when forming perceptions. When exposed to just a product name, especially for a whole food product like fruit or an egg, consumers are likely to perceive the product as natural. These perceptions can be altered, however, with the inclusion of an ingredient/subcomponent statement. A long statement with a high volume of unfamiliar chemical names causes consumers to rely more on the ingredient/subcomponent statement than the product identity when making decisions about naturalness. This is evident by the difference between the Peach and the Banana. The Peach received the lowest mean naturalness scores when unidentified and significantly higher scores when identified. The identity of the Banana on the other hand was never hidden from consumers. Since the consumer rescored the naturalness of the Peach without the ingredient statement attached, it was perceived as significantly more natural than the Banana, which was paired with its statement when consumers were asked to rate naturalness. The presence of unfamiliar, chemical sounding ingredients/subcomponents and ingredients/subcomponents with E-numbers
was more influential to consumers than the product identity as a whole and caused naturalness ratings to drop.

References


Department of Health and Human Services; Use of the Term “Natural” in the Labeling of Human Food Products; Request for Information and Comments, 80 Fed. Reg. 69905 (November 12, 2015) (to be codified at 21 C.F.R. Part 101).


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doi:10.1017/S1368980012003205.


Appendix A - Natural Color Survey

Screener

Q1. Which of the following best describes your gender?
   - Male
   - Female

Page Break

Q2. Which of the following best describes your age?
   - Under 18 years
   - 18 – 23
   - 24 – 41
   - 42 – 52
   - 53 – 73
   - 74 or older

Page Break

Q3. Please estimate the percentage of the household grocery shopping that you personally do.
   - 0 – 20%
   - 21 – 40%
   - 41 – 60%
   - 61 – 80%
   - More than 80%

Page Break

Survey

Q1. Please read the ingredient label and answer the following questions.

Ingredients: Corn, Vegetable Oil (Sunflower, Canola, and/or Corn Oil), Maltodextrin (Made from Corn), Salt, Cheddar Cheese (Milk, Cheese Cultures, Salt, Enzymes), Whey, Monosodium Glutamate, Buttermilk, Romano Cheese (Part-Skim Cow’s Milk, Cheese Cultures, Salt, Enzymes), Whey Protein Concentrate, Onion Powder, Corn Flour, Natural and Artificial Flavor, Dextrose, Tomato Powder, Lactose, Spices, Artificial Color (Including Yellow 6, Yellow 5, and Red 40), Lactic Acid, Citric Acid, Sugar, Garlic Powder, Skim Milk, Red and Green Bell Pepper Powder, Disodium Inosinate, and Disodium Guanylate.

Based on the ingredient list above, how likely are you to purchase this food?
   - Extremely unlikely
   - Moderately unlikely
Based on the ingredient list above, how natural do you think this food is?

- Not at all natural – 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- Extremely Natural – 9

Chose all of the following statements that you think apply to this ingredient list (Check all that apply)

- Too long
- Has artificial colors
- Too short
- Has chemical names
- I have a diagnosed allergy to one or more of the ingredients
- Has natural colors
- Food sounds gross
- Food sounds tasty
- Contains unnatural ingredients
- Ingredients come from nature
- Ingredients made in a lab
- Has unhealthy ingredients
- Ingredients cause cancer
- Has healthy ingredients
- Not appropriate for kids
- Don’t recognize ingredients
- Extra color added
- Extra flavor added
- Ingredients cause Attention Deficit Disorder (ADD)/Attention Deficit Hyper Disorder (ADHD)
o I believe I am sensitive to one or more of these ingredients

Which of the following ingredients do you think are sources of color in this food? (Check all that apply)

- Corn
- Vegetable Oil (Sunflower, Canola, and/or Corn Oil)
- Maltodextrin (Made from Corn)
- Salt
- Cheddar Cheese (Milk, Cheese Cultures, Salt, Enzymes)
- Whey
- Monosodium Glutamate
- Buttermilk
- Romano Cheese (Part-Skim Cow's Milk, Cheese Cultures, Salt, Enzymes)
- Whey Protein Concentrate
- Onion Powder
- Corn Flour
- Natural and Artificial Flavor
- Dextrose
- Tomato Powder
- Lactose
- Spices
- Artificial Color (Including Yellow 6, Yellow 5, and Red 40)
- Lactic Acid
- Citric Acid
- Sugar
- Garlic Powder
- Skim Milk
- Red and Green Bell Pepper Powder
- Disodium Inosinate
- Disodium Guanylate

Q2. Please read the ingredient label and answer the following questions.

**Ingredients:** Enriched Bleached Flour (Wheat Flour, Barley Malt, Niacin, Reduced Iron, Thiamin mononitrate [Vitamin B1], Riboflavin [Vitamin B2], Folic Acid), Water, Sugar, Palm Oil, Dextrose, Palm and Soybean Oils with TBHQ and Citric Acid to protect flavor, Yeast.

Contains 2% or less of each of the following: Soy Flour, Nonfat Dry Milk, Dried Honey, Eggs, Cinnamon, Cocoa, Wheat Starch, Leavening (Baking Soda, Sodium Acid Pyrophosphate), Corn Starch, Mono- and Diglycerides, Soybean Oil, Salt, Calcium Stearoyl Lactylate, Calcium Carbonate, Agar, Calcium Sulfate, Calcium Propionate and Potassium Sorbate (to preserve
Based on the ingredient list above, how likely are you to purchase this food?

- Extremely unlikely
- Moderately unlikely
- Unlikely
- Slightly unlikely
- Neither likely nor unlikely
- Slightly likely
- Likely
- Moderately likely
- Extremely likely

Based on the ingredient list above, how natural do you think this food is?

- Not at all natural – 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- Extremely Natural – 9

Chose all of the following statements that you think apply to this ingredient list (Check all that apply)

- Too long
- Has artificial colors
- Too short
- Has chemical names
- I have a diagnosed allergy to one or more of the ingredients
- Has natural colors
- Food sounds gross
- Food sounds tasty
- Contains unnatural ingredients
- Ingredients come from nature
- Ingredients made in a lab
- Has unhealthy ingredients
- Ingredients cause cancer
- Has healthy ingredients
- Not appropriate for kids
- Don’t recognize ingredients
- Extra color added
- Extra flavor added
- Ingredients cause Attention Deficit Disorder (ADD)/Attention Deficit Hyper Disorder (ADHD)
- I believe I am sensitive to one or more of these ingredients

Which of the following ingredients do you think are sources of color in this food? (Check all that apply)

- Enriched Bleached Flour (Wheat Flour, Barley Malt, Niacin, Reduced Iron, Thiamin mononitrate [Vitamin B1], Riboflavin [Vitamin B2], Folic Acid) (1)
- Water
- Sugar
- Palm Oil
- Dextrose
- Palm and Soybean Oils with TBHQ and Citric Acid
- Yeast
- Soy Flour
- Nonfat Dry Milk
- Dried Honey
- Eggs
- Cinnamon
- Cocoa
- Wheat Starch
- Leavening (Baking Soda, Sodium Acid Pyrophosphate)
- Corn Starch
- Mono- and Diglycerides
- Soybean Oil
- Salt
- Calcium Stearoyl Lactylate
- Calcium Carbonate
- Agar
- Calcium Sulfate
- Calcium Propionate and Potassium Sorbate
- Ascorbic Acid
- Calcium Peroxide
- Amylase Enzymes
- Datem
- Soy Lecithin
- Natural Colors (Annatto Extract, Titanium Dioxide, Turmeric)
Q3. Please read the ingredient label and answer the following questions,

**Ingredients:** Milk Chocolate (Sugar, Chocolate, Skim Milk, Cocoa Butter, Lactose, Milkfat, Soy Lecithin, Salt), Sugar, Cornstarch, Less than 1% - Corn Syrup, Dextrin, Coloring (Includes Blue 1 Lake, Yellow 6, Red 40 Lake, Blue 2 Lake, Yellow 6 Lake, Yellow 5 Lake, Blue 2), Gum Acacia.

Based on the ingredient list above, how likely are you to purchase this food?

- Extremely unlikely
- Moderately unlikely
- Unlikely
- Slightly unlikely
- Neither likely nor unlikely
- Slightly likely
- Likely
- Moderately likely
- Extremely likely

Based on the ingredient list above, how natural do you think this food is?

- Not at all natural – 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- Extremely Natural – 9

Chose all of the following statements that you think apply to this ingredient list (Check all that apply)

- Too long
- Has artificial colors
- Too short
- Has chemical names
- I have a diagnosed allergy to one or more of the ingredients
- Has natural colors
- Food sounds gross
Food sounds tasty
Contains unnatural ingredients
Ingredients come from nature
Ingredients made in a lab
Has unhealthy ingredients
Ingredients cause cancer
Has healthy ingredients
Not appropriate for kids
Don’t recognize ingredients
Extra color added
Extra flavor added
Ingredients cause Attention Deficit Disorder (ADD)/Attention Deficit Hyper Disorder (ADHD)
I believe I am sensitive to one or more of these ingredients

Which of the following ingredients do you think are sources of color in this food? (Check all that apply)

- Milk Chocolate (Sugar, Chocolate, Skim Milk, Cocoa Butter, Lactose, Milkfat, Soy Lecithin, Salt)
- Sugar
- Cornstarch
- Corn Syrup
- Dextrin
- Coloring (Includes Blue 1 Lake, Yellow 6, Red 40 Lake, Blue 2 Lake, Yellow 6 Lake, Yellow 5 Lake, Blue 2)
- Gum Acacia

Q4. Please read the ingredient label and answer the following questions.

**Ingredients:** Tapioca Syrup, Cane Sugar, Tapioca Syrup Solids, Pear Juice Concentrate, Water, Pectin, Citric Acid, Carrot Juice Concentrate, Sweet Potato Juice Concentrate, Sodium Citrate, Ascorbic Acid (Vitamin C), Sunflower Oil, Color (black carrot, blackcurrant, annatto extracts), Lemon Juice Concentrate, Carnauba Wax.

Based on the ingredient list above, how likely are you to purchase this food?

- Extremely unlikely
- Moderately unlikely
- Unlikely
- Slightly unlikely
- Neither likely nor unlikely
Based on the ingredient list above, how natural do you think this food is?

- Slightly likely
- Likely
- Moderately likely
- Extremely likely

Based on the ingredient list above, how natural do you think this food is?

- Not at all natural – 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- Extremely Natural – 9

Chose all of the following statements that you think apply to this ingredient list (Check all that apply)

- Too long
- Has artificial colors
- Too short
- Has chemical names
- I have a diagnosed allergy to one or more of the ingredients
- Has natural colors
- Food sounds gross
- Food sounds tasty
- Contains unnatural ingredients
- Ingredients come from nature
- Ingredients made in a lab
- Has unhealthy ingredients
- Ingredients cause cancer
- Has healthy ingredients
- Not appropriate for kids
- Don’t recognize ingredients
- Extra color added
- Extra flavor added
- Ingredients cause Attention Deficit Disorder (ADD)/Attention Deficit Hyper Disorder (ADHD)
- I believe I am sensitive to one or more of these ingredients
Which of the following ingredients do you think are sources of color in this food? (Check all that apply)

- Tapioca Syrup
- Cane Sugar
- Tapioca Syrup Solids
- Pear Juice Concentrate
- Water
- Pectin
- Citric Acid
- Carrot Juice Concentrate
- Sweet Potato Juice Concentrate
- Sodium Citrate
- Ascorbic Acid (Vitamin C)
- Sunflower Oil
- Color (black carrot, blackcurrant, annatto extracts)
- Lemon Juice Concentrate
- Carnauba Wax

Page Break

Q5. Please read the ingredient label and answer the following questions.

**Ingredients:** Wheat Flour, Sugar, Egg, Red 40, Baking Powder.

Based on the ingredient list above, how likely are you to purchase this food?

- Extremely unlikely
- Moderately unlikely
- Unlikely
- Slightly unlikely
- Neither likely nor unlikely
- Slightly likely
- Likely
- Moderately likely
- Extremely likely

Based on the ingredient list above, how natural do you think this food is?

- Not at all natural – 1
- 2
- 3
- 4
- 5
- 6
- 7
Chose all of the following statements that you think apply to this ingredient list (Check all that apply)

- Too long
- Has artificial colors
- Too short
- Has chemical names
- I have a diagnosed allergy to one or more of the ingredients
- Has natural colors
- Food sounds gross
- Food sounds tasty
- Contains unnatural ingredients
- Ingredients come from nature
- Ingredients made in a lab
- Has unhealthy ingredients
- Ingredients cause cancer
- Has healthy ingredients
- Not appropriate for kids
- Don’t recognize ingredients
- Extra color added
- Extra flavor added
- Ingredients cause Attention Deficit Disorder (ADD)/Attention Deficit Hyper Disorder (ADHD)
- I believe I am sensitive to one or more of these ingredients

Which of the following ingredients do you think are sources of color in this food? (Check all that apply)

- Wheat Flour
- Sugar
- Egg
- Red 40
- Baking Powder

Q6. Please read the ingredient label and answer the following questions.

**Ingredients:** Enriched Corn Flour, Canola Oil, Salt, Yellow 5.

Based on the ingredient list above, how likely are you to purchase this food?
• Extremely unlikely
• Moderately unlikely
• Unlikely
• Slightly unlikely
• Neither likely nor unlikely
• Slightly likely
• Likely
• Moderately likely
• Extremely likely

Based on the ingredient list above, how natural do you think this food is?

• Not at all natural – 1
• 2
• 3
• 4
• 5
• 6
• 7
• 8
• Extremely Natural – 9

Chose all of the following statements that you think apply to this ingredient list (Check all that apply)

• Too long
• Has artificial colors
• Too short
• Has chemical names
• I have a diagnosed allergy to one or more of the ingredients
• Has natural colors
• Food sounds gross
• Food sounds tasty
• Contains unnatural ingredients
• Ingredients come from nature
• Ingredients made in a lab
• Has unhealthy ingredients
• Ingredients cause cancer
• Has healthy ingredients
• Not appropriate for kids
• Don’t recognize ingredients
• Extra color added
• Extra flavor added
Ingredients cause Attention Deficit Disorder (ADD)/Attention Deficit Hyper Disorder (ADHD)
I believe I am sensitive to one or more of these ingredients

Which of the following ingredients do you think are sources of color in this food? (Check all that apply)
- Enriched Corn Flour
- Canola Oil
- Salt
- Yellow 5

Q7. Please read the ingredient label and answer the following questions.

**Ingredients:** Distilled White Vinegar, Water, Mustard Seed, Natural Color, Salt.

Based on the ingredient list above, how likely are you to purchase this food?
- Extremely unlikely
- Moderately unlikely
- Unlikely
- Slightly unlikely
- Neither likely nor unlikely
- Slightly likely
- Likely
- Moderately likely
- Extremely likely

Based on the ingredient list above, how natural do you think this food is?
- Not at all natural – 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- Extremely Natural – 9

Chose all of the following statements that you think apply to this ingredient list (Check all that apply)
Which of the following ingredients do you think are sources of color in this food? (Check all that apply)

- Distilled White Vinegar
- Water
- Mustard Seed
- Natural Color
- Salt

Q8. Please read the ingredient label and answer the following questions.

**Ingredients:** Water, Sugar, Citric Acid, Natural Color.

Based on the ingredient list above, how likely are you to purchase this food?

- Extremely unlikely
- Moderately unlikely
- Unlikely
- Slightly unlikely
- Neither likely nor unlikely
- Slightly likely
Based on the ingredient list above, how natural do you think this food is?

- Not at all natural – 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- Extremely Natural – 9

Chose all of the following statements that you think apply to this ingredient list (Check all that apply)

- Too long
- Has artificial colors
- Too short
- Has chemical names
- I have a diagnosed allergy to one or more of the ingredients
- Has natural colors
- Food sounds gross
- Food sounds tasty
- Contains unnatural ingredients
- Ingredients come from nature
- Ingredients made in a lab
- Has unhealthy ingredients
- Ingredients cause cancer
- Has healthy ingredients
- Not appropriate for kids
- Don’t recognize ingredients
- Extra color added
- Extra flavor added
- Ingredients cause Attention Deficit Disorder (ADD)/Attention Deficit Hyper Disorder (ADHD)
- I believe I am sensitive to one or more of these ingredients
Which of the following ingredients do you think are sources of color in this food? (Check all that apply)

- Water
- Sugar
- Citric Acid
- Natural Color

Q9. Choose all of the sources you believe natural colors for food can come from. (Check all that apply)

- Fruit Juice
- Fruit
- Insects
- Chemicals
- Algae
- Vegetables
- Meat
- Flowers
- Beans
- Extracts
- Vitamins
- Minerals
- Animal Skins or Bones
- Roots
- Food Dyes
- Grains
- Clay
- Sea Weed
- Beneficial Microorganisms
- Leaves
- Bark

Q10. Choose all of the sources you believe natural flavors for food can come from. (Check all that apply)

- Fruit Juice
- Fruit
- Insects
- Chemicals
- Algae
- Vegetables
- Meat
Q11. Choose all of the foods that you have consumed in the past week. (Check all that apply)

- Apples
- Bread
- Live worms
- Hot dogs/Frankfurters
- Beef
- Cheese
- Ice Cream
- Chocolate
- Pickled chicken
- Potato chips/crisps
- Strawberry yogurt
- Eggs
- Vegetable Stew

Q12. Based on the following ingredient list, how natural do you think this food is?

**Ingredients:** Invert Sugar, Corn Syrup, Strawberry Puree Concentrate, Sugar, Glycerin, Modified Cornstarch, Sodium Alginate, Citric Acid, Monocalcium Phosphate, Dicalcium Phosphate, Methylcellulose, Malic Acid, Fruit and Vegetable Juice for Color (Radish, Apple and Blackcurrant concentrates), Natural Flavors.

- Not at all natural – 1
- 2
- 3
- 4
- 5
Q13. Based on the following ingredient list, how natural do you think this food is?

**Ingredients:** Enriched Corn Meal (Corn Meal, Ferrous Sulfate, Niacin, Thiamin Mononitrate, Riboflavin, and Folic Acid), Vegetable Oil (Corn, Canola, and/or Sunflower Oil), Seasoning (Maltodextrin (Made from Corn), Salt, Sugar, Monosodium Glutamate, Yeast Extract, Citric Acid, Artificial Color (Red 40 Lake, Yellow 6 Lake, Yellow 6, Yellow 5), Sunflower Oil, Cheddar Cheese (Milk, Cheese Cultures, Salt, Enzymes), Onion Powder, Whey, Whey Protein Concentrate, Garlic Powder, Natural Flavors, Buttermilk, Sodium Diacetate, Disodium Inosinate, Disodium Guanylate), and Salt.

- Not at all natural – 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- Extremely Natural – 9

Q14. Based on the following ingredient list, how natural do you think this food is?

**Ingredients:** Corn Syrup, Sugar, Gelatin, Modified Food Starch (Corn), Fumaric Acid, Lactic Acid, Citric Acid, Sodium Citrate, Calcium Lactate, Sodium Lactate, Artificial Flavors, Yellow 5, Red 40, Yellow 6, Blue 1.

- Not at all natural – 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- Extremely Natural – 9
Q15. Based on the following ingredient list, how natural do you think this food is?

**Ingredients:** Cultured Grade A Non Fat Milk, Water, Modified Food Starch, Cane Sugar, Blueberries, Contains Less Than 1% of Kosher Gelatin, Fruit Juice and Vegetable Juice (For Color), Artificial Flavors, Sucralose, Malic Acid, Acesulfame Potassium, Vitamin A Palmitate, Vitamin D3, Sodium Citrate, Active Cultures L. Bulgaricus & S. Thermophilus.

- Not at all natural – 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- Extremely Natural – 9

Q16. This is an ingredient statement for Strawberry Puree. Based on the following ingredient list, how natural do you think this food is?

**Ingredients:** Invert Sugar, Corn Syrup, Strawberry Puree Concentrate, Sugar, Glycerin, Modified Cornstarch, Sodium Alginate, Citric Acid, Monocalcium Phosphate, Dicalcium Phosphate, Methylcellulose, Malic Acid, Fruit and Vegetable Juice for Color (Radish, Apple and Blackcurrant concentrates), Natural Flavors.

- Not at all natural – 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- Extremely Natural – 9

Q17. This is an ingredient statement for Flamin’ Hot Cheetos. Based on the following ingredient list, how natural do you think this food is?

**Ingredients:** Enriched Corn Meal (Corn Meal, Ferrous Sulfate, Niacin, Thiamin Mononitrate, Riboflavin, and Folic Acid), Vegetable Oil (Corn, Canola, and/or Sunflower Oil), Seasoning (Maltodextrin (Made from Corn), Salt, Sugar, Monosodium Glutamate, Yeast Extract, Citric
Acid, Artificial Color (Red 40 Lake, Yellow 6 Lake, Yellow 6, Yellow 5), Sunflower Oil, Cheddar Cheese (Milk, Cheese Cultures, Salt, Enzymes), Onion Powder, Whey, Whey Protein Concentrate, Garlic Powder, Natural Flavors, Buttermilk, Sodium Diacetate, Disodium Inosinate, Disodium Guanylate), and Salt.

- Not at all natural – 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- Extremely Natural – 9

Q18. This is an ingredient statement for Gummy Candy. Based on the following ingredient list, how natural do you think this food is?

**Ingredients:** Corn Syrup, Sugar, Gelatin, Modified Food Starch (Corn), Fumaric Acid, Lactic Acid, Citric Acid, Sodium Citrate, Calcium Lactate, Sodium Lactate, Artificial Flavors, Yellow 5, Red 40, Yellow 6, Blue 1.

- Not at all natural – 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- Extremely Natural – 9

Q19. This is an ingredient statement for Blueberry Yogurt. Based on the following ingredient list, how natural do you think this food is?

**Ingredients:** Cultured Grade A Non Fat Milk, Water, Modified Food Starch, Cane Sugar, Blueberries, Contains Less Than 1% of Kosher Gelatin, Fruit Juice and Vegetable Juice (For Color), Artificial Flavors, Sucralose, Malic Acid, Acesulfame Potassium, Vitamin A Palmitate, Vitamin D3, Sodium Citrate, Active Cultures L. Bulgaricus & S. Thermophilus.

- Not at all natural – 1
Q20. Based on the following ingredient list, how natural do you think this food is?

**Ingredients:** Water, Sugars (Sucrose, Glucose, Fructose, Maltose, Galactose), Fiber E460, Fatty Acids (Omega-6 Fatty Acid: Octadecadienoic Acid, Octadecenoic Acid, Hexadecanoic Acid, Octadecanoic Acid, Hexadecenoic Acid, Omega-3 Fatty Acid: Octadecatrienoic Acid), Amino Acids (Aspartic Acid, Glutamic Acid, Lysine, Serine, Alanine, Leucine, Glycine, Valine, Threonine, Arginine, Histidine, Proline, Cystine, Isoleucine, Tyrosine, Phenylalanine, Tryptophan, Methionine), Colors (Carotene E160a, Lutein E161b, Xanthophyll E161c), Ascorbic Acid (E300), Alpha-Tocopherol (E307), Flavors (Benzaldehyde, Linalool, Gamma- and Delta-Decalactone, Delta- and Gamma-Octalactone, 6-Pentyl-Alpha-Pyrone, Hexadecanoic Acid, (Z)-3-Hexen-1-yl Acetate, Ethyl Butanoate, (Z)-3-Hexanal, Hexanal, (E,E)-2,4-Decadienal, Benzaldehyde, Delta- and Gamma-Dodecalactone, Gamma-Jasmolactone, Terpinolene, 4-Decanolide, Beta-Damascenone, Carvomenthenal, Alpha-Terpineol, 3-Methyl-Butyl Acetate), Choline, Pantothenic Acid.

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- Extremely Natural – 9

Page Break

Q21. The ingredient statement on the previous page is an actual list for a fresh Peach. How natural do you think this food is now?

- Not at all natural – 1
- 2
Q22. Based on the following ingredient list, how natural do you think this food is?

**Ingredients:** Water, Sugars (Glucose, Fructose, Galactose, Maltose, Sucrose), Fiber E460, Ash, Fatty Acids (Octadecaenoic Acid, Omega-6 Fatty Acid: Octadecadienoic Acid, Omega-3 Fatty Acid: Octadecatrienoic Acid, Hexadecanoic Acid, Octadecanoic Acid, Hexadecaenoic Acid, Tetradecanoic Acid), Amino Acids (Aspartic Acid, Glutamic Acid, Proline, Serene, Leucine, Alanine, Lysine, Phenylalanine, Glycine, Threonine, Valine, Arginine, Histidine, Isoleucine, Tyrosine, Methionine, Cysteine, Tryptophan), Colors (Carotene E160a, Lutein E161b, Xanthophyll E161c), Ascorbic Acid (E300), Alpha-Tocopherol (E307), Choline, Phytosterols, Flavors ((Z)-3-Hexenol, 2-Heptanone, Cinnamic Alcohol, Cinnamic Aldehyde, (E)-2,6-Nonanedianal, (E)-2-Hexenal, Hexanal, Eugenol, Linalool, Benzaldehyde, Phenylacetaldehyde).

- Not at all natural – 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- Extremely Natural – 9

Q23. The ingredient statement on the previous page is an actual list for fresh Cherries. How natural do you think this food is now?

- Not at all natural – 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- Extremely Natural – 9
Q24. If a Banana was required to have an ingredient list, the following would be its actual ingredient statement. Based on the ingredient statement for a Banana, how natural do you think a Banana is?

**Ingredients:** Water, Sugars (Glucose, Fructose, Sucrose, Maltose), Starch, Fiber E460, Amino Acids (Glutamic Acid, Aspartic Acid, Histidine, Leucine, Lysine, Phenylalanine, Arginine, Valine, Alanine, Serine, Glycine, Threonine, Isoleucine, Proline, Tryptophan, Cystine, Tyrosine, Methionine), Fatty Acids (Palmitic Acid, Omega-6 Fatty Acid: Linoleic Acid, Omega-3 Fatty Acid, Linolenic Acid, Oleic Acid, Palmitoleic Acid, Stearic Acid, Lauric Acid, Myristic Acid, Capric Acid), Ash, Phytosterols, Potassium Sulfate (E515), Oxalic Acid, Ascorbic Acid (E300), Tocopherol (E306), Phylloquinone, Thiamin, Colors (Yellow-Orange E101 (Riboflavin), Yellow-Brown E160a), Flavors (3-Methylbut-1-yl Ethanoate, 2-Methylbutyl Ethanoate, 2-Methylpropan-1-ol, 3-Methylbutyl-1-ol, 2-Hydroxy-3-Methylethyl Butanoate, 3-Methylbutanal, Ethyl Hexanoate, Ethyl Butanoate, Pentyl Acetate), Ethanol (1510), Natural Ripening Agent (Ethene Gas).

- Extremely Natural – 9

Q25. If a Chicken Egg was required to have an ingredient list, the following would be its actual ingredient statement. Based on the ingredient statement for a Chicken Egg, how natural do you think a Chicken Egg is?

- Not at all natural – 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- Extremely Natural – 9
Demographic Questions

Q1. Which of the following best describes your gender?
   - Male
   - Female

Q2. Which of the following best describes your age?
   - Under 18 years
   - 18 – 23
   - 24 – 41
   - 42 – 52
   - 53 – 73
   - 74 or older

Q3. Which of the following best describes your race/ethnicity? (US)
   - American Indian/Alaska Native
   - Asian
   - Black/African American
   - Hispanic/Latino
   - Native Hawaiian/Pacific Islander
   - White/Caucasian
   - Other (Please Specify)______
   - Prefer not to answer

Q3. Which of the following best describes your race/ethnicity? (UK)
   - Asian
   - Black/African/Caribbean
   - Hispanic/Latino
   - White/Caucasian
   - Other (Please Specify)______
   - Prefer not to answer

Q3. Which of the following best describes your race/ethnicity? (AUS)
   - Asian
   - Black/African
o Hispanic/Latino
  o Pacific Islander
  o White/Caucasian
  o Aboriginal/Torres Strait Islander
  o Other (Please Specify)______
  o Prefer not to answer

Q4. Which of the following best describes your education level?
  o High School or less
  o Associate Degree/Some College/1-2 year Technical Degree
  o College Degree/3-4 year Professional Degree
  o Postgraduate College Degree
  o Prefer not to answer

Q5. Which of the following best describes you total gross annual household income last year?

(UUS)
  o Less than $25,000
  o $25,000 - $49,999
  o $50,000 - $74,999
  o $75,000 - $99,999
  o $100,000 - $149,999
  o More than $150,000
  o Prefer not to answer

(UUK)
  o Less than £20,000
  o £20,000 - £39,999
  o £40,000 - £59,999
  o £60,000 - £79,999
  o £80,000 - £99,999
  o More than £100,000
  o Prefer not to answer

(UAUS)
  o Less than $52,000
  o $52,000 - $103,999
  o $104,000 - $155,999
Q6. How many children do you have in your household?
- No Children
- 1 Child
- 2 Children
- 3 Children
- 4 or More Children

Q7. Please indicate how often you consume the following foods.

<table>
<thead>
<tr>
<th>Food</th>
<th>Never</th>
<th>Once a month or less often</th>
<th>2-4 times a month</th>
<th>2-3 times a week</th>
<th>4 or more times a week</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toaster Pastries</td>
<td>○</td>
<td>○</td>
<td>○</td>
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Q8. How often do you read ingredient statements when purchasing food products?
   - Never
   - Rarely
   - Occasionally
   - Most of the time
   - Always

Q9. How often do you pay attention to the source of **food coloring** on ingredient labels when purchasing food products?
   - Never
   - Rarely
   - Occasionally
   - Most of the time
   - Always

Q10. How often do you pay attention to the source of **food flavoring** on ingredient labels when purchasing food products?
   - Never
   - Rarely
   - Occasionally
   - Most of the time
   - Always

Q11. When you read an ingredient label, how important is the source of **color**?
   - Extremely important
   - Very important
   - Moderately important
   - Slightly important
   - Not at all important

Q12. When you read an ingredient label, how important is the source of **flavor**?
   - Extremely important
   - Very important
   - Moderately important
   - Slightly important
   - Not at all important
Q13. How likely are you to not purchase a food if it contains artificial colors?
   o Extremely unlikely
   o Moderately unlikely
   o Unlikely
   o Slightly unlikely
   o Neither likely nor unlikely
   o Slightly likely
   o Likely
   o Moderately likely
   o Extremely likely

Q14. How likely are you to not purchase a food if it contains artificial flavors?
   o Extremely unlikely
   o Moderately unlikely
   o Unlikely
   o Slightly unlikely
   o Neither likely nor unlikely
   o Slightly likely
   o Likely
   o Moderately likely
   o Extremely likely

Please rate the extent to which you agree or disagree with the following statements

Q15. I am very particular about the healthiness of food.
   o Strongly disagree
   o Moderately disagree
   o Disagree
   o Somewhat disagree
   o Neither agree nor disagree
   o Somewhat agree
   o Agree
   o Moderately Agree
   o Strongly Agree

Q16. I always follow a healthy and balanced diet.
   o Strongly disagree
   o Moderately disagree
Q17. It is important to me that my diet is low in fat.
   - Strongly disagree
   - Moderately disagree
   - Disagree
   - Somewhat disagree
   - Neither agree nor disagree
   - Somewhat agree
   - Agree
   - Moderately Agree
   - Strongly Agree

Q18. It is important to me that my diet contains a lot of vitamins and minerals.
   - Strongly disagree
   - Moderately disagree
   - Disagree
   - Somewhat disagree
   - Neither agree nor disagree
   - Somewhat agree
   - Agree
   - Moderately Agree
   - Strongly Agree

Q19. I eat what I like and I do not worry about the healthiness of food.
   - Strongly disagree
   - Moderately disagree
   - Disagree
   - Somewhat disagree
   - Neither agree nor disagree
   - Somewhat agree
   - Agree
   - Moderately Agree
   - Strongly Agree
Q20. I do not avoid any foods, even if they may raise my cholesterol.
  o Strongly disagree
  o Moderately disagree
  o Disagree
  o Somewhat disagree
  o Neither agree nor disagree
  o Somewhat agree
  o Agree
  o Moderately Agree
  o Strongly Agree

Q21. The healthiness of food has little impact on my food choices.
  o Strongly disagree
  o Moderately disagree
  o Disagree
  o Somewhat disagree
  o Neither agree nor disagree
  o Somewhat agree
  o Agree
  o Moderately Agree
  o Strongly Agree

Q22. The healthiness of snacks makes no difference to me.
  o Strongly disagree
  o Moderately disagree
  o Disagree
  o Somewhat disagree
  o Neither agree nor disagree
  o Somewhat agree
  o Agree
  o Moderately Agree
  o Strongly Agree

Q23. I do not care about additives in my daily diet.
  o Strongly disagree
  o Moderately disagree
  o Disagree
  o Somewhat disagree
  o Neither agree nor disagree
  o Somewhat agree
Q24. In my opinion, organically grown foods are not better for my health than those grown conventionally.
    o Strongly disagree
    o Moderately disagree
    o Disagree
    o Somewhat disagree
    o Neither agree nor disagree
    o Somewhat agree
    o Agree
    o Moderately Agree
    o Strongly Agree

Q25. In my opinion, artificially colored foods are not harmful for my health.
    o Strongly disagree
    o Moderately disagree
    o Disagree
    o Somewhat disagree
    o Neither agree nor disagree
    o Somewhat agree
    o Agree
    o Moderately Agree
    o Strongly Agree

Q26. In my opinion, artificially flavored foods are not harmful for my health.
    o Strongly disagree
    o Moderately disagree
    o Disagree
    o Somewhat disagree
    o Neither agree nor disagree
    o Somewhat agree
    o Agree
    o Moderately Agree
    o Strongly Agree

Q27. I try to eat foods that do not contain additives.
    o Strongly disagree
Q28. I would like to eat only organically grown vegetables.
   - Strongly disagree
   - Moderately disagree
   - Disagree
   - Somewhat disagree
   - Neither agree nor disagree
   - Somewhat agree
   - Agree
   - Moderately Agree
   - Strongly Agree

Q29. I do not eat processed foods because I do not know what they contain.
   - Strongly disagree
   - Moderately disagree
   - Disagree
   - Somewhat disagree
   - Neither agree nor disagree
   - Somewhat agree
   - Agree
   - Moderately Agree
   - Strongly Agree

Q30. I look for only Non-GMO (Non-Genetically Modified Organism) ingredients on the food I eat.
   - Strongly disagree
   - Moderately disagree
   - Disagree
   - Somewhat disagree
   - Neither agree nor disagree
   - Somewhat agree
   - Agree
Q31. I always look for natural ingredients in the snack foods that I eat.
   - Strongly disagree
   - Moderately disagree
   - Disagree
   - Somewhat disagree
   - Neither agree nor disagree
   - Somewhat agree
   - Agree
   - Moderately Agree
   - Strongly Agree

Q32. If I do not understand the name of an ingredient or if the name is unfamiliar, I do not buy the food product.
   - Strongly disagree
   - Moderately disagree
   - Disagree
   - Somewhat disagree
   - Neither agree nor disagree
   - Somewhat agree
   - Agree
   - Moderately Agree
   - Strongly Agree

Q33. I do not care about natural ingredients in the snack foods that I eat.
   - Strongly disagree
   - Moderately disagree
   - Disagree
   - Somewhat disagree
   - Neither agree nor disagree
   - Somewhat agree
   - Agree
   - Moderately Agree
   - Strongly Agree

Q34. I do not read ingredient statements and do not worry about natural ingredients.
   - Strongly disagree
   - Moderately disagree
End of Survey

- Disagree
- Somewhat disagree
- Neither agree nor disagree
- Somewhat agree
- Agree
- Moderately Agree
- Strongly Agree